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THE STRIKE OF TELEGRAPH OPERATORS IN AMERICA.

THE strike of telegraph operators in the United States, which had been threatened, has taken place, and though the consequences are no doubt unpleasant to the general public, no serious results have as yet arisen therefrom. This, of course, is in a very great measure due to the fact that but one-third of the general body of operators seems to have joined in the movement. In America the use of the telegraph for general purposes is more extensive than it is in this country, telegrams being sent in very many cases where the use of the post would have fully answered the object required; the partial cessation, therefore, of the more rapid means of communication cannot probably, up to the present, be considered as more than vexatious.

As to how far the operators are justified in the extreme course they have pursued, in the absence of statistics, we are unable to express an opinion; but the fact that a large body of men who occupy a good social position should consider that such an extreme measure as a strike is necessary to a great extent justifies the action taken, as we cannot believe that the mere extortion of extra pay by might exercised against right can be the motive.

As compared with the strike which recently took place in this country the circumstances are different. A service carried on by a public company is one thing, a service carried on by the Government is another; in the former case the matter may be entirely a question whether the company can afford to pay higher salaries than they do. A certain amount of capital invested is expected to yield a certain return, and if the latter becomes very much reduced something must be done to raise it again to its normal value; or, again, if the return can only be kept up by keeping expenses down, obviously any attempt to increase the latter must be resisted. If it can be shown in the case of the American operators that the earnings of the company, in whose employ they are, are unreasonably high, and that their own pay is not up to its real market value, then undoubtedly the demands are just, but if, on the other hand, it can be shown that the company cannot earn a reasonable profit unless the salaries are kept low, then in this case, although the operators may feel the inconvenience of being badly paid, yet they cannot have much cause to grumble. In the Government service profit is not so much an object as efficiency, and an increase of expenditure, although it will reduce the net revenue, may only result in bringing the profit to a very low figure or even to reducing it to nothing. This would only affect the public in so far that any extension of the service may have to be delayed unless the former pays for it by increased taxation. The fact that large concessions were granted in the case of the recent agitations in the Government telegraph service proved that the demands were to a great extent justifiable, more especially as public opinion was not adverse to the increased expenditure. Public opinion, however, in the case of *employés* in a public company, although it must have some weight, cannot have the influential power that it has in the case of the service of the crown, as only a certain section are directly interested from a pecuniary point of view. How the American strike will end it is difficult to foresee with certainty, telegraph operators even of the most indifferent type cannot be made in a day, as the duties until thoroughly learnt do not become mechanical. Although no doubt there are many old or amateur hands who would be willing to fill the places of those on strike, yet we should doubt if the number would be sufficient to give very material assistance, more particularly as the sympathy of the bulk of those who are capable of assisting would be with those who have refused to work.

INDUCED CURRENTS IN A MAGNETIC FIELD.

By LIEUT. J. B. MURDOCK, U. S. Navy.

(*Concluded from page* 42.)

WE have thus far considered the case in which a current is flowing in the circuit at first, but the same rules apply in cases where there is no initial current. The formula

$$CR = E - \frac{(N_1 - N_2)}{t},$$

being true for all values of E, must hold when $E = 0$, but in that case CR is the E.M.F. in circuit

$$= - \frac{(N_1 - N_2)}{t}$$

as before. This appears also from the fact that by diminishing t, by increasing the velocity of the circuit, the induced E.M.F. may be made to equal or overcome that previously existing, and there would eventually be a current flowing in the same direction, whether a current existed in the circuit at first or not. On the supposition that $E = 0$ (1) (page 42), becomes

$$0 = C^2Rt + C(N_1 - N_2) \quad . \quad . \quad (2)$$

or

$$CR = - \frac{(N_1 - N_2)}{t},$$

as above. As in this equation the original energy was zero, the energy of the induced current can be derived only from the work done in moving the coil, and if no external work is done by the coil, the energy thus applied appears as heat in the circuits.

The E.M.F. induced in the time, t, being numerically equal to the change in the number of lines of force enclosed and acting by Lenz' law in such a direction as by its electromagnetic action to oppose the cause inducing it, must tend to cause a current flowing in such a manner as to keep the number of lines enclosed by the circuit constant. If a coil be moved so as to enclose a smaller number, the induced current must add enough to make the loss good; if moved so as to enclose a greater number, the induced current would cause enough to pass in the opposite direction to neutralise the gain. Consider the case of a coil moved along the lines of force, the observer looking along them in the positive direction. If, in the movement, the coil encloses a decreasing number, the induced current must make good the deficiency, and this by the rule already given for the relation between the direction of the lines of force and that of the current would be done by a right-handed or direct current, one flowing in the direction in which the hands of a watch move. If the coil moved enclosing an increasing number, the gain would be neutralised by the lines due to a left-handed or inverse current. Hence the rule given by Silvanus Thompson in his "Elementary Lessons"—"a decrease in the number of lines of force which pass through a circuit produces a current around the circuit in a positive direction, while an increase in the number of lines of force produces a current in the negative direction around the circuit." This rule is

general, and is most useful, but in its application it must be remembered that the currents appear positive or negative to an observer looking along the lines of force in the direction in which a free north pole would move. Viewed from the other side they would of course appear to pass in the opposite direction. These relations, although somewhat difficult to reason out, are easily verified by experiment. It may be well to illustrate the application of the rules given. Suppose the lines of force to pass down perpendicularly through the paper, and a coil to be at rest in the plane of the paper. It encloses a maximum number of lines of force, and if rotated so that the right-hand edge comes to the front, while the left-hand goes behind the paper, it will enclose a constantly decreasing number of lines, and a positive current will be induced. The E.M.F. will at first be small, as the rate of change is small, the edges of the coil moving almost along the lines of force. The rate will gradually increase until the coil has moved through one quadrant and is edge on to the observer, when, as the motion of the edges is at right angles to the lines, the rate, and consequently the E.M.F., is a maximum. In this position the coil encloses no lines of force, and during the second quadrant it will move, enclosing an increasing number, and inducing, therefore, an inverse current. But the side of the coil now seen is the opposite to that in view during the first quadrant, and the inverse current is therefore in the same absolute direction in the coil as the former direct current. During the second quadrant the rate and E.M.F. decrease, becoming a minimum when the coil has completed a half revolution and is again in the plane of the paper. On entering the third quadrant, the number of lines enclosed decreases, and a direct current is induced; but as the same side of the coil is presented to the observer as in the second, the direction of the current is reversed in the coil. In the fourth quadrant the number of enclosed lines increases, but the other side of the coil is towards the observer, so that the absolute direction of the current is the same as in the third. The general direction of the current is therefore downward in that part of the coil in front of the paper, and upward in the outer half; but as regards the coil itself, the direction of the current changes twice in every revolution, the point of change being where the circuit encloses the maximum number of lines of force. By the use of a commutator which shifts its connections at this point of the revolution, the current may be made to flow in one direction in the exterior circuit.

It now remains to trace the practical application of these results. In the formula for the induced E.M.F. let N denote $(N_1 - N_2)$, or be the change in the time, t, in the number of lines of force enclosed by the circuit. It is extremely difficult to obtain numerical values for N_1 and N_2, but it requires very little experimenting with magnets and iron filings to trace the general direction of the lines of force in any combination of magnets. All treatises on electricity or physics contain diagrams illustrating the distribution of the lines of force in different cases, and as the formula does not require any absolute value, but only a change or difference of values, this can be inferred with considerable exactness from an examination of the arrangement of the magnets in the field. From the formula, therefore,

$$E = \frac{N}{t}$$

the following considerations are easily deduced:

1. The E.M.F. varies as the change in the strength of the field. If the coil passes from a position in which it encloses no lines, to another in which it encloses N lines, the latter should be as great as possible. If it moves alternately in a positive and in a negative field, the algebraic difference should be as great as possible. This relation is commonly given that the E.M.F. varies as the strength of field, but it is possible to move a coil in the most intense uniform field without inducing any current.

2. The E.M.F. varies as the velocity. If N lines are cut in a time t, the shorter t the greater the E.M.F. Theoretically, therefore, the E.M.F. of a dynamo varies as the speed, and this relation is so nearly true in practice as to be always assumed in calculation.

3. The formula gives the E.M.F. induced in a single circuit. In a coil of n turns each encloses the same number of lines of force, and each would therefore induce the same E.M.F. But the turns being in series the total E.M.F. in the coil would be n times that in one turn. If each of the n turns were moved in the field separately, n times the work required to move one turn would be done, and this amount of work must also be done when the whole coil is moved at once. The E.M.F. varies, therefore, with the number of turns in the moving coil, but as the outer turns enclose more lines than the inner, the ratio of gain would be slightly greater than the number of turns.

4. In a coil rotating with uniform angular velocity, the rate of change of the lines of force enclosed would be greatest where the coil cuts them at right angles, or where the plane of the coil is parallel to the lines of force.

5. The larger the coil the greater the number of lines passing through it, and other conditions remaining the same, the E.M.F. varies as the area of the coil. A difficulty exists in making the armature larger and keeping the intensity of the field constant. Pole-pieces are frequently used to accomplish this end, but may work disadvantageously.

Perfect working in a dynamo requires a constant change of E.M.F., and consequently a constant rate. If a large coil should revolve between the poles of two bar magnets, and no iron were present to modify the distribution of the lines of force in the field, the greater part would pass directly between the poles, and would be cut during a small part of the revolution of the coil, during which time the rate and induced E.M.F. would be high, but in other parts of the revolution the rate would be very small. The available E.M.F. would be induced suddenly, but the sudden creation of a current causes high self-induction and temporary strong extra currents, which in a dynamo are not only prejudicial but dangerous, on account of the high E.M.F. they may have. Idle wire in the armature also reduces the current. It is therefore desirable to prevent a concentration of the lines of force in a small part of the field. In a coil rotating in a uniform field, the advantage of the constant rate is attained by the change of the number of lines enclosed in the ratio of the sine of the angle between the plane of the coil and the direction of the lines, and as a field tends to become uniform so would this advantage be gained. Pole-pieces, by increasing the magnetic surface, operate favourably, but if they encircle the armature so closely as to approach each other nearly, lines of force will pass from one to the other which are not cut at all by the coil in its revolution. Experiments have shown that in some cases the E.M.F. is increased by cutting off the edges of the pole-pieces. Edison has apparently carried this advantage to the utmost, the long magnets and immense pole-pieces of his machines tending to secure a field more nearly uniform than in other types.

THE MEASUREMENT OF LOW RESISTANCES.

THE dynamo-electric machines, like the conductors generally employed in electro-metallurgy, offer only very low resistances, and when it is necessary to measure these resistances, which are sometimes only a few millionths of an ohm, the ordinary methods become very complicated and almost impracticable.

"I will describe," says M. Lossier in *L'Electricien*, "an indirect and very simple method, in which there is nothing new, but which has, nevertheless, been of great service to me, and will, I think, prove useful to the ever-increasing number of electricians studying electro-metallurgy.

"Let us suppose that we wish to measure the resistance, R, of a large conductor between the points, A and B, this conductor being traversed by a current of known strength, I.

"To the two points, A and B, are applied the two wires of a galvanometer, G, graduated very accurately in fractions of an ampère. The resistance, r, of the circuit, A G B, has been determined once for all; i being the strength of the derivation current measured at the galvanometer, we get, according to the laws of Kirchhoff, in the closed circuit, A C B G:

$$RI - ri = 0$$

whence:

$$R = \frac{ri}{I}$$

"We have therefore only to measure the current strengths, which offers no difficulty.

"I should add that the current strength, I, between the points, A and B, not being exactly the same as in the rest of the principal circuit, we ought, properly speaking, to measure it between these points, A and B.

"However, the resistance of this conductor being insignificant in comparison with that of the derivation circuit, we may content ourselves with taking, without making any correction, the strength measured at any point whatever of the principal circuit.

"The following are a few examples selected at random from among the numerous measurements that I have been called upon to make by this method :—

1. Large copper conductor with section of 25 square centimetres.

$I = 937$ ampères,
$i = 0{\cdot}00145$ ampères,
$r = 100$ ohms ;

whence we get

$R = 0{\cdot}000155$ ohms.

2. Two conductors connected together in a trough of mercury.

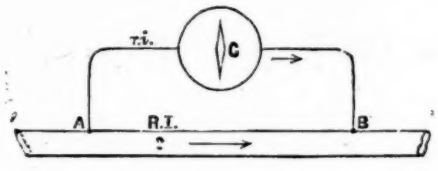
$I = 942$ ampères,
$i = 0{\cdot}00011$ ampères,
$r = 100$ ohms ;

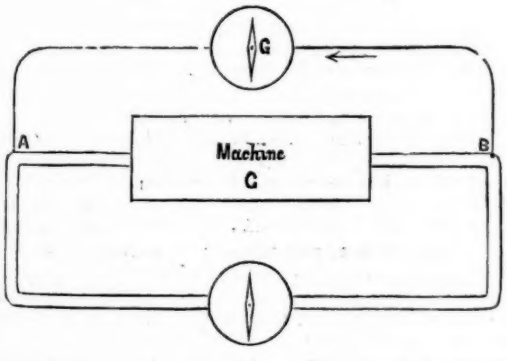
whence we get

$R = 0{\cdot}0000116$ ohms.

3. The internal resistance of a machine in action.*

Here we must modify the above formula, because in the circuit to be measured there is an electromotive force, E (the electromotive force of the machine), which must be taken





into consideration, and also that the strengths, I and i, are both reckoned to be of the same nature, and consequently become positive in the formula.

We have therefore in the circuit A, C, B, G,

$$R\,I + r\,i = E,$$

whence

$$R = \frac{E - r\,i}{I}.$$

Experiment a.

a. $E = 2{\cdot}1$ volts,
$I = 1150$ ampères,
$i = 0{\cdot}011$ ampères,
$r = 100$ ohms.
$R = 0{\cdot}00087$ ohms.

Experiment b.

b. $E = 3{\cdot}6$ volts,
$I = 1680$ ampères,
$i = 0{\cdot}017$ ampères,
$r = 100$ ohms.
$R = 0{\cdot}00113$ ohms.

* Powerful electrolytic double-circuit machine manufactured by the Société Genévoise de Constructions Mécaniques à Genève, giving 5,000 ampères and 4·5 volts.

A NEW OXIDE OF COPPER BATTERY.

By MM. F. DE LALANDE and G. CHAPERON.

WE have succeeded in forming a new battery with a single liquid and with a solid depolarising element by associating oxide of copper, caustic potash and zinc.

This battery possesses remarkable properties. Depolarising electrodes are easily formed of oxide of copper. It is enough to keep it in contact with a plate or a cell of iron or copper constituting the positive pole of the element.

FIG 1.

Fig. 1 represents a very simple arrangement. At the bottom of a glass jar, V, we place a box of sheet-iron, A, containing oxide of copper, B. To this box is attached a copper wire insulated from the zinc by a piece of india-rubber tube. The zinc is formed of a thick wire of this metal coiled in the form of a flat spiral, D, and suspended from a cover, E, which carries a terminal, F, connected with the zinc ; an india-rubber tube, G, covers the zinc at the place where it dips into the liquid, to prevent its being eaten away at this level.

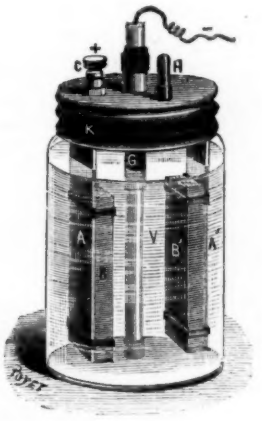


FIG. 2.

The jar is filled with a solution containing 30 or 40 per cent. of potash. This arrangement is similar to that of a Callaud element, with this difference that the depolarising element is solid and insoluble.

To prevent the inconveniences of the manipulation of the potash we enclose a quantity of this substance in the solid

state necessary for an element, in the box which receives the oxide of copper and furnish it with a cover supported by a ring of caoutchouc. It suffices then for working the battery to open the box of potash, to place it at the bottom of the jar and to add water to dissolve the potash; we then pour in the copper oxide enclosed in a bag.

We also form the oxide of copper very conveniently into blocks. Among the various means which might be employed, we prefer the following:—

We mix with the oxide of copper oxychloride of magnesium in the form of paste so as to convert the whole into a thick mass, which we introduce into metal boxes.

The mass sets in a short time, or very rapidly by the action of heat, and gives porous blocks of a solidity increasing with the quantity of cement employed (5 to 10 per cent.).

Fig. 2 represents an arrangement with blocks. The jar, V, is provided with a cover of copper, E, screwing into the glass. This cover carries two vertical plates of sheet-iron, A, A′, against which are fixed the prismatic blocks, B, B′, by means of india-rubber bands. The terminal, C, carried by the cover constitutes the positive pole. The zinc is formed of a single pencil, D, passing into a tube fixed to the centre of the cover. The india-rubber, G, is folded back upon this tube so as to make an air-tight joint.

The cover carries, besides, another tube, H, covered by a split india-rubber tube which forms a safety valve.

The closing is made hermetical by means of an india-rubber tube, K, which presses against the glass and the cover. The potash to charge the element is in pieces, and is contained either in the glass jar itself or in a separate box of sheet-iron.

Applying the same arrangement, we form hermetically-sealed elements with a single plate of a very small size.

The employment of cells of iron, cast-iron, or copper, which are not attacked by the exciting liquid, allows us to easily construct elements exposing a large surface (fig. 3).

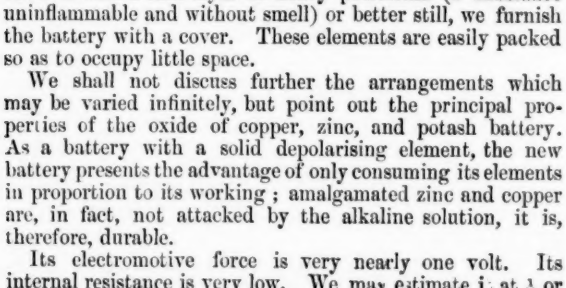


FIG. 3.

The cell, A, forming the positive pole of the battery is of iron plate brazed upon vertical supports; it is 40 centimetres long by 20 centimetres wide, and about 10 centimetres high.

We cover the bottom with a layer of oxide of copper and place in the four corners porcelain insulators, L, which support a horizontal plate of zinc, D, D′, raised at one end and kept at a distance from the oxide of copper and from the metal walls of the cell; three-quarters of this is filled with a solution of potash. The terminals, C and M, fixed respectively to the iron cell and to the zinc, serve to attach the leading wires. To avoid the too rapid absorption of the carbonic acid of the air by the large exposed surface, we cover it with a thin layer of heavy petroleum (a substance uninflammable and without smell) or better still, we furnish the battery with a cover. These elements are easily packed so as to occupy little space.

We shall not discuss further the arrangements which may be varied infinitely, but point out the principal properties of the oxide of copper, zinc, and potash battery. As a battery with a solid depolarising element, the new battery presents the advantage of only consuming its elements in proportion to its working; amalgamated zinc and copper are, in fact, not attacked by the alkaline solution, it is, therefore, durable.

Its electromotive force is very nearly one volt. Its internal resistance is very low. We may estimate it at $\frac{1}{3}$ or $\frac{1}{4}$ of an ohm for polar surfaces one decimetre square, separated by a distance of five centimetres.

The rendering of these couples is considerable; the small cells shown in figs. 1 and 2, give about two ampères in short-circuit, the large one gives 16 to 20 ampères. Two of these elements can replace a large Bunsen cell. They are remarkably constant. We may say that with a depolarising surface double that of the zinc the battery will work without notable polarisation, and almost until completely exhausted even under the most unfavourable conditions. The transformation of the products, the change of the alkali into an alkaline salt of zinc does not perceptibly vary the internal resistance. This great constancy is chiefly due to the progressive reduction of the depolarising electrode to the state of very conductive metal, which augments its conductivity and its depolarising power.

The peroxide of manganese, which forms the base of an excellent battery for giving a small rendering, possesses at first better conductivity than oxide of copper, but this property is lost by reduction and transformation into lower oxides. It follows that the copper battery will give a very large quantity of electricity working through low resistances, whilst under these conditions manganese batteries are rapidly polarised.

The energy contained in an oxide of copper and potash battery is very great, and far superior to that stored by an accumulator of the same weight, but the rendering is much less rapid. Potash may be employed in concentrated solution at 30, 40, 60 per cent.; solid potash can dissolve the oxide of zinc furnished by a weight of zinc more than one-third of its own weight. The quantity of oxide of copper to be employed exceeds by nearly one-quarter the weight of zinc which enters into action. These data allow of the reduction of the necessary substances to a very small relative weight.

The oxide of copper batteries have given interesting results in their application to telephones. For theatrical purposes the same battery may be employed during the whole performance, instead of four or five batteries. Their durability is considerable; three elements will work continuously, night and day, Edison's carbon microphones for more than four months without sensible loss of power.

Our elements will work for a hundred hours through low resistances, and can be worked at any moment, after several months, for example. It is only necessary to protect them by a cover from the action of the carbonic acid of the atmosphere.

We prefer potash to soda for ordinary batteries, notwithstanding its price and its higher equivalent, because it does not produce, like soda, creeping salts. Various modes of regeneration render this battery very economical. The deposited copper absorbs oxygen pretty readily by simple exposure to damp air, and can be used again. An oxidising flame produces the same result very rapidly.

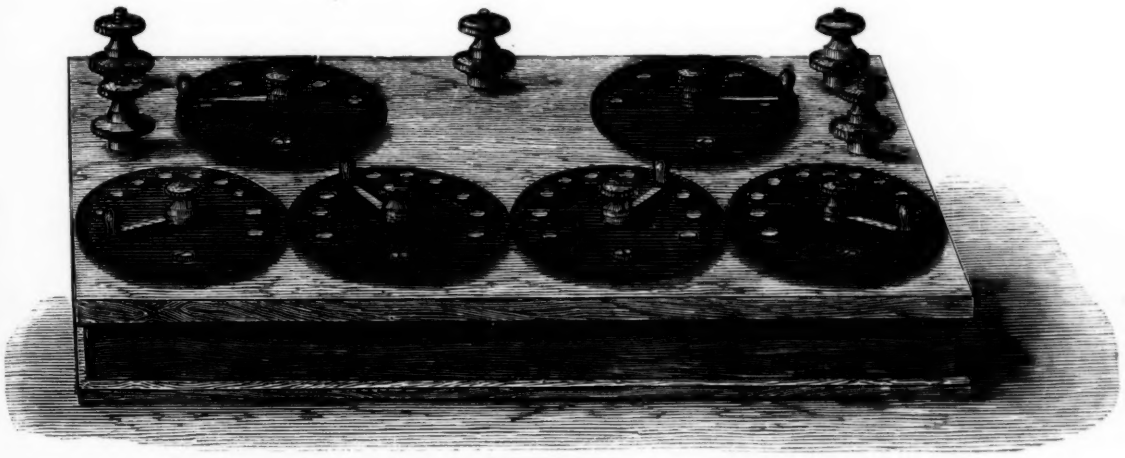
Lastly, by treating the exhausted battery as an accumulator, that is to say, by passing a current through it in the opposite direction, we restore the various products to their original condition; the copper absorbs oxygen, and the alkali is restored, whilst the zinc is deposited; but the spongy state of the deposited zinc necessitates its being submitted to a process, or to its being received upon a mercury support. Again, the oxide of copper which we employ being a waste product of brazing and plate works unless it be reduced, loses nothing of its value by its reduction in the battery, the depolarisation may therefore be considered as costing scarcely anything. The oxide of copper battery is a durable and valuable battery, which, by its special properties seems likely to replace advantageously in a great number of applications the batteries at present in use.

Glasgow Science Lectures Association.—Arrangements have been made for the delivery, during the coming winter, of lectures by the following:—Prof. R. S. Ball, LL.D., F.R.S., Astronomer-Royal for Ireland; Capt. W. de W. Abney, R.E., F.R.S., South Kensington Museum; Prof. Cleland, M.D., D.Sc., LL.D., F.R.S., University of Glasgow; Prof. Archibald Geikie, LL.D., F.R.S., Director-General of the Geological Survey of Great Britain; Rev. W. H. Dallinger, F.R.S., Principal of the Wesley College, Sheffield; and Prof. Fleeming Jenkin, C.E., LL.D., F.R.S., University of Edinburgh.

A RHEOSTAT BRIDGE.

THE form of Wheatstone's bridge shown in the illustration has been devised by Mr. W. Groves to obviate the use of loose plugs as in the ordinary resistance boxes, and also to provide an instrument more easily manipulated and at a less cost than heretofore and equally suitable for purposes where actual standard measurements are not required. The apparatus has six dials, of which the two upper ones represent the proportional parts, which are marked 0, 10, 100, and 1,000. The four lower dials contain the adjustable resistances divided into units, tens, hundreds, and thousands. Each of these dials has ten contact studs and each stud is numbered with its corresponding resistance, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

By operating the respective handles attached to each dial the resistance to be measured is found in the same way as



in the ordinary "dial pattern" bridge with its single peg to each set of units, tens, &c.

The contacts are of platinum and the whole arrangement of the instrument is such that every portion may be readily cleaned, an operation sometimes exceedingly difficult in certain forms of Wheatstone's bridges.

We are not aware that such a design has been brought forward prior to this of Mr. Groves, and although many electricians prefer the use of plugs we think that the new form of bridge will find hosts of admirers, it being in our opinion specially adapted to the use of the electric light engineer. It is easily carried about, there are no plugs to lose, and the method of manipulating the instrument enables one to take a test more rapidly than with any other with which we are acquainted.

NOTE ON THE MEASUREMENT OF THE ELECTRIC RESISTANCE OF LIQUIDS.*

By Professors W. E. AYRTON, F.R.S., and JOHN PERRY, M.E.

SOME time back a paper was communicated by Profs. Reinold and Rücker to this Society on the Resistance of Liquid Films, which had a double interest, arising from the great value of the results arrived at, and from the method employed to obtain them. It is, of course, well known that the great difficulty in measuring the resistance of a liquid arises from the polarisation of, or actual deposit of, gases on the anode and cathode, which makes the apparent resistance of the liquid far greater than the true value. To overcome this difficulty Kohlrausch employed rapidly alternating currents, and Dr. Guthrie with Mr. Boys dispensed altogether with the anode and cathode by observing the amount of twist produced in a fine steel wire supporting a vessel of liquid when a magnet was rotated at a fixed speed in the neighbourhood.

But there is another method of measuring the resistance of a liquid independently of its polarisation, the one so successfully employed by Profs. Reinold and Rücker, and which consists in measuring by means of an electrometer the potential difference at two fixed points in a column of the liquid when a current of known strength is passing through it.

At the time the professors communicated their paper we mentioned that some years previously certain experiments had been conducted in our laboratory in Japan for the purpose of ascertaining how far the electrometer method of measuring the resistance of a liquid was entirely independent of polarisation, and as we have since come across the results of these experiments in turning over some papers we have thought that the information may possess some interest for the members of this Society. The experiments were made at the commencement of 1878 by some of our students, and the first part of the investigation was for the purpose of ascertaining how the resistance of water varied with the electromotive force employed and with the temperature of the water; when, first, the resistance was measured by the current which a known electromotive force could send between platinum plates of known size and at fixed distances apart in the water, and, secondly, when the resistance was measured by a comparison of the potential differences of two platinum wires placed in the water at fixed distances apart, with the potential differences when the same current was being sent through a known resistance.

Figs. 1 and 2 show the arrangement of the apparatus used in the experiments.

B is the battery producing the current passing between the platinum plates, P and P'. G is a delicate reflecting galvanometer measuring the current. E is a quadrant electrometer, which measures the difference of potentials between the two wires, W and W'. These two platinum wires, W and W', were immersed in glass tubes, and their ends were above the bottom of the glass tubes as shown. Fig. 1 shows the connections when the difference of potentials between W and W' as being measured by the electrometer, and fig. 2 when the difference of potentials at the two ends of the known resistance coil of 10,000 ohms as being measured.

The following table gives the dimensions of the various parts of the apparatus:—

Diameter of the beaker at water-line	8·5	centimetres
Height of water-line above the bottom	5·76	,,
Distance between centres of wire tubes (w w' in fig. 2)	4·88	,,
Distance between the pt. plates	7·3	,,
Part of the wire tube (w) dipped in water	2·14	,,
Part of the pt. wire in water	0·91	,,
Outside diameter	0·87	,,
Size of pt. plate height	3·28	,,
,, ,, width	2·29	,,

Before each experiment, when no current was passing, the difference of potentials between the plates and wires was reduced to 0, if not 0 already, the wires W and W' were

* Communicated to the Physical Society. Read June 9th, 1883.

heated to redness before each experiment, and the platinum plates cleaned.

At the beginning pure distilled water was used, and this water was not added to all the time, it therefore lost a little by evaporation during the course of the experiment, and may have become a little dusty, but as the main object of the

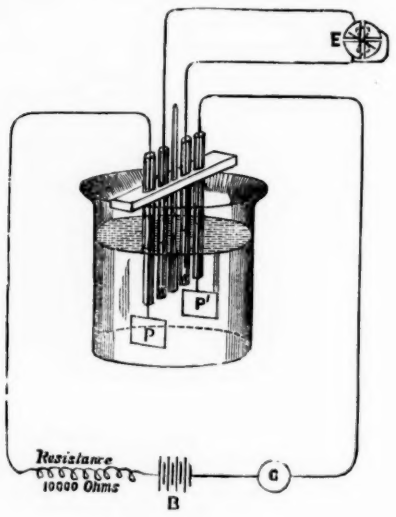


FIG. 1.

investigation was to examine the method of testing and not for the purpose of measuring the specific resistance of water or of any other particular liquid the impurity was of little consequence.

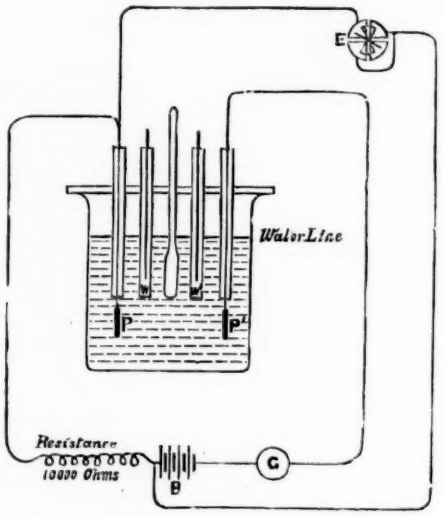


FIG. 2.

The following is a sample of the experiments made January 25th, 1878.

Battery-power employed $\frac{1}{6}$th of 23 Daniell cells, having an E.M.F. of 4·08 volts, and which gave a deflection of 468 divisions on the galvanometer when shunted with the $\frac{1}{1000}$th shunt, and when a resistance of 10,000 ohms was introduced in the the circuit.

Time after putting on battery.	Galvanometer deflection.	Electrometer deflection.		Temperature.
		Fig. 1.	Fig 2.	
1	99	10	—	59°·5 F.
2	96	10	—	
3	94	10	—	

Plates and wires thoroughly discharged,

1	99	..	14	61°
2	98	..	14	
3	90	..	14	

Time after putting on battery.	Resistance as determined by the galvanometer.	Resistance as determined by the electrometer.
1	37,000	7,100
2	38,000	7,100
3	39,000	7,100

The annexed table gives the results of a long series of experiments :—

	Total electromotive force in volts.	Temperature.	Resistance as determined by galvanometer at the end of one minute.	Ratio of resistance at the end of second minute to the resistance at the end of the first.	Ratio of resistance at the end of third minute to the resistance at the end of the first.	Resistance as determined by electrometer.	Ratio of resistance determined by galvanometer to resistance as determined by electrometer.	Date.
		Deg. F.						
	0·93	58	93,900	1·27	1·4	15,000	6·26	Jan. 23
	..	60	133,000	1·12	1·37	15,000	8·87	,, 23
A	0·93	100	56,000	1·16	1·27	8,000	7·00	,, 24
	1·86	63	53,000	1·10	1·14	10,670	5	,, 24
	1·86	62	51,500	1·12	1·18	10,300	5	,, 24
B	1·86	102	32,000	1·17	1·27	9,670	3·31	,, 24
	4·08	59·5	37,000	1·03	1·05	7,100	5·21	,, 25
	4·08	102	19,800	1·01	1·06	3,270	6·06	,, 28
	6·17	60	21,000	1·0	1·0	4,450	4·72	,, 28
C	6·17	106	12,000	1·08	1·08	2,700	4·44	,, 31
	16·45	62	12,700	1·01	0·99	3,170	4·01	,, 31
D	16·45	107	7,700	1·04	1·04	1,953	3·94	,, 31

Only one number is given for the resistance as determined by the electrometer in each case, because it was found not to vary much with the time of electrification, whereas the resistance as determined by the galvanometer, as will be seen, increased in the earlier experiments 30 to 40 per cent. during the three minutes' electrification.

The total electromotive force in each case was determined by making a comparison by means of the electrometer with one of Clark's standard cells.

From these observations the following conclusions may be drawn :—1st. The resistance measured by the galvanometer is much greater when using about one volt than when using nearly two, at the same temperature (compare observations A and B), whereas the electrometer measurements altered very little at all. Again, comparing C and D, we see that the resistance measured by the galvanometer is much greater when using 6 volts than when using 16·45. In this case, however, the measurements of the electrometer are also considerably greater in the first case than in the second, the temperature being the same. 2nd. If the electromotive force is less than the decomposing electromotive force, then the smaller it is the more does the resistance alter from one to two minutes' electrification and from two to three minutes. Whenever, however, the electromotive force is sufficiently high for decomposition to take place the electrification seems to produce but little change in the resistance. The resistance of the water diminishes as the temperature rises, the electromotive force being kept constant.

The following experiments were made preliminary to explorations of the region between the two platinum plates in the water, for determining what were the directions of the lines of flow of current. We desired to see if there was any chance of being able to use platinum wires in glass tubes connected with the electrometer as previously described.

In the following cases a long trough of water was used instead of the beaker.

The sensibility of the galvanometer was nearly the same throughout all the experiments, and was such that $\frac{1}{10}$th of the whole electromotive force employed produced a deflection of about 500 divisions when there was an external resistance of 10,000 ohms, and when the multiplying power

of the shunt employed was 100·7, which shunt was used throughout all the experiments.

Four Menotti cells, having an electromotive force of 8·7 volts, were employed in each of the following experiments:—In A, B, C, D, E, F, and G, the two platinum plates were placed parallel to one another at a distance of 90 centimetres apart. The two wires and their glass tubes were placed to commence at a distance of 80 centimetres, that is, each being 5 centimetres from the platinum plate. The lower ends of the platinum wires were each 1½ centimetres above the lower end of the glass tubes, and the lower ends of the glass tubes were one centimetre below the surface of the water. The two platinum plates and one of the platinum wires were kept immovable, while the other platinum wire was moved along the trough.

February 21st, 1878.

	Distance between platinum wires.	Time after putting on battery.	Galvanometer deflection.	Electrometer deflection.	Temperature of water.
A	80 c.m.	1′ 0″	669	53	13° C.
	60 ,,	1′ 30″	662	40	
	40 ,,	1′ 50″	658	27	
	20 ,,	2′ 15″	654	15	
B	80 c.m.	1′ 0″	667	52	13° C.
	60 ,,	1′ 25″	663	39	
	40 ,,	1′ 45″	657	27	
	20 ,,	2′ 10″	653	15	

February 22nd, 1878.

	Distance between platinum wires.	Time.	Galvanometer deflection.	Electrometer deflection.	Temperature.
C	80 c.m.	1′ 0″	680	50	13° C.
	60 ,,	1′ 35″	675	37	
	42 ,,	2′ 10″	672	26	
	20 ,,	2′ 30″	670	15	
D	80 c.m.	1′ 0″	685	49	13° C.
	60 ,,	1′ 20″	680	37	
	40 ,,	1′ 50″	677	24	
	20 ,,	2′ 10″	674	12	
E	80 c.m.	1′ 0″	697	48	13° C.
	60 ,,	1′ 20″	692	36	
	40 ,,	1′ 50″	688	24	
	20 ,,	2′ 20″	685	13	
F	80 c.m.	1′ 0″	699	50	13° C.
	60 ,,	1′ 35″	694	37	
	40 ,,	1′ 50″	690	25	
	20 ,,	2′ 15″	687	13	
G	80 c.m.	1′ 0″	over 717	51	13° C.
	60 ,,	1′ 30″	,,	38	
	40 ,,	2′ 0″	,,	25	
	20 ,,	2′ 20″	,,	15	

The object, of course, of taking the galvanometer readings was to insure that no material change was taking place in the current through the weakening of the battery or otherwise while the experiment was being made.

The experiments E and F appear the most satisfactory of this set, and from these it seems that the resistance of the upper layer of water column is nearly proportional to the distance between the platinum wires except for the nearest distance, in which case the column seems to have a slightly larger resistance than it ought to have. This perhaps arose from the fact that although the platinum plates nearly filled up the entire section of the trough still that the lines of flow at the platinum wire which was kept stationary at a distance of five centimetres from one of the plates were not quite parallel to the edge of the trough.

The two following sets of experiments, H and I, differ from the preceding in only that the lower end of the glass tube was one centimetre above the bottom of the trough and from these two sets of experiments we see that the resistance of the lower layer of water column as measured by the electrometer is nearly proportional to the distance between the wires except again for the shortest distance.

	Distance between platinum wires.	Time after putting on battery.	Galvanometer deflection.	Electrometer deflection.	Temperature of water.
H	80 c.m.	1′ 0″	709	50	
	60 ,,	1′ 35″	703	37·5	
	40 ,,	2′ 0″	700	26	
	20 ,,	2′ 20″	698	13	
I	80 c.m.	1′ 0″	704	49	
	60 ,,	1′ 20″	700	37	
	40 ,,	1′ 45″	796	25	
	20 ,,	2′ 20″	792	13	

The next experiments were for the purpose of seeing whether the potential as measured by the electrometer would come out uniform at all points in one vertical transverse section of the trough as well as at all points in one of the glass tubes.

	Distance between the platinum wires, W and W′, in centimetres.	Position of the lower end of one of the tubes.	Galvanometer deflection.	Electrometer deflection.
J	80	Up	696	49
	80	Down	692	49
	80	Up	689	49

"Up" means that the lower end of the glass tube was about 1 centimetre below the surface of the water and "Down" that it was about 1 centimetre above the bottom of the glass trough. The platinum wire was now raised about 4 centimetres above the bottom of the glass tube when the glass tube was down and the electromotive force was unaltered. The potential therefore at all points in a vertical transverse section, as well as at all points in the glass tube, is the same as measured by the electrometer.

The next set of experiments, K and L, were made under exactly the same conditions as A, B, C, D, E, F, and G, with the exception that the terminal platininm plates were now perpendicular to each other, the plate towards which the wire was moved being parallel to the long side of the trough.

	Distance between the platinum wires in centimetres.	Time after putting on battery.	Galvanometer deflection.	Electrometer deflection.	Temperature.
K	80	1′ 0″	706	51	13°C
	60	1′ 30″	701	38	
	40	1′ 50″	699	27	
	20	2′ 0″	697	15	
L	80	1′ 0″	705	51	13°C
	60	1′ 30″	701	40	
	40	1′ 55″	698	27	
	20	2′ 20″	697	15	

The resistance of the longer column of the water as measured by the electrometer is about the same as before, whereas that of the shorter is even greater, so that the resistance for the 80 centimetre column is even still less than four times that for the 20 centimetre one. But since the platinum plate near the stationary platinum wire was (in these two last sets of experiments, K and L) kept parallel to the trough, that is parallel to the mean direction of the lines of flow, it follows that any want of parallelism of the lines of flow to the edge of the trough at the point where was the stationary wire would be exaggerated by this mode of placing the plate, and since we observe that the error in the proportional law for distance is also increased we may conclude that the explanation given above of the want of perfect accuracy in the proportional law being due to want of perfect parallelism in the lines of flow is the correct one.

In all the previous experiments the distance between the electrometer wires only was altered, but in the next set both the distance between the platinum plates as well as that between the platinum wires was altered, the distance between each plates and wire being kept constant. Further, the resistance as determined from the electrometer was calculated,

not as before by comparing the electrometer deflection when its electrodes were attached to the platinum wires with the deflection obtained, when its ends were attached to a known resistance traversed by the same current, but by first determining the absolute value in volts of the electrometer scale with the absolute value in ampères of the galvanometer scale and by observing the electrometer and galvanometer deflections in each experiment.

Battery-power employed, 4 Menotti cells, temperature 14° C.
Distance between the platinum plates, 20 centimetres.
" " " wires, 10 "
Shunt $\frac{1}{990\cdot2}$.

Time after putting on battery, in minutes.	Galvanometer deflection.	Electrometer deflection.	Resistance as determined by galvanometer (in ohms.)	Resistance as determined by electrometer (in ohms.)
1	230	19	27,000	11,340
2	220	19	28,000	11,760
3	214	18·5	29,000	11,900
4	210	18	29,600	11,840
5	206	17	30,000	11,400

Distance between the platinum plates 90 centimetres.
" " " wires 80 "
Shunt $\frac{1}{100\cdot7}$.

1	634	42	97,000	90,200
2	621	42	98,980	92,070
3	614	42	99,960	92,900
4	608	41	100,940	91,900
5	602	41	111,960	101,900

Distance between the platinum plates .. 90 centimetres
" " " wires .. 80 "
Shunt $\frac{1}{100\cdot7}$

Time in minutes after putting on battery.	Galvanometer deflection.	Electrometer deflection.	Resistance as determined by galvanometer (in ohms.)	Resistance as determined by electrometer (in ohms.)
1	633	43	97,000	93,100
2	621	42	98,000	91,100
3	614	42	99,000	92,100
4	609	42	100,000	93,000
5	604	41	101,000	92,000

Distance between the platinum plates .. 20 centimetres
" " " wires .. 10 "
Shunt $\frac{1}{990\cdot2}$

1	245	21	25,500	11,900
2	235	20	26,600	11,700
3	230	20	27,200	11,960
4	225	19	27,800	11,670
5	220	19	28,400	11,930

The resistance, therefore, as measured by the galvanometer does not increase as rapidly as the distance separating the plates, while that as measured by the electrometer is fairly in proportion to the distance. The explanation of the former is probably due to the fact that since the electromotive force employed in all these four sets of experiments was constant a greater current flowed when the plates were nearer than when they were far apart, hence that the resistance due to the layer of gas was greater when the plates were near than when they were far.

And this leads to a simple method of accurately measuring the resistance of liquids by using a galvanometer. The method which was independently arrived at by one of our assistants, Mr. Mather, is now employed in our laboratory, and is so simple that we feel it can hardly be novel. It is as follows:—In a long, vertical glass tube containing the liquid there are two metallic discs, not necessarily of platinum, and of about the same diameter as the tube. One of these can slide up and down the tube, so as to be able to be set at any fixed distance from the other. The discs are first put tolerably far apart, and a certain convenient current made to flow, and which is measured on a galvanometer in the circuit. The plates are now made to approach and the current kept exactly the same by the insertion of an external resistance, whence it follows that the resistance of the column of liquid which has been subtracted from that originally separating the plates is equal exactly to the external resistance necessary to be inserted to keep the current constant.

February 28th, 1878.

The next set of experiments was made to determine the alteration in resistance of a long trough of water when the distance between the centres of the platinum plates was kept constant at 90 centimetres, and the positions of the platinum plates varied as shown in the figures.

Galvanometer constant.—4 Menotti cells with an E.M.F. of 3·8 volts gave a deflection of 618 when a resistance of 10,000 ohms was in circuit and the galvanometer shunted with the $\frac{1}{990\cdot2}$th shunt.

The four Menotti cells were employed and the galvanometer shunted with the $\frac{1}{100\cdot7}$th shunt, and the readings were in each case taken one minute after the application of the battery.

Position of plates.	Galvanometer deflection	Temperature.
I.	642	16° C.
	640	
	622	
II.	634	16° C.
	643	
	647	

Two sets of experiments in the reverse order were taken to eliminate any change that might take place in the deflection from weakening of the battery, or from polarisation of the plates, or from a set of the galvanometer fibre.

The constant distance between the centres of the plates was now diminished to 20 centimetres, when the following results were obtained, the $\frac{1}{990\cdot2}$th shunt being employed.

Position of plates.	Galvanometer deflection.	Temperature.
III.	245	16° C.
	291	
	304	
VI.	315	16° C.
	285	
	239	

Both, therefore, at the greater and at the less distance the resistance is least when the platinum plates are edge on, a result that could hardly have been expected for the longer distance considering that the width of each plate was only about 6 centimetres.

March 1st, 1878.

In the following experiments one plate only was turned, the galvanometer had about the same sensibility as before the $\frac{1}{100\cdot7}$th shunt was used, when the distance between the centre of the plates was 90 centimetres, and the $\frac{1}{990\cdot2}$th shunt, when it was 20 centimetres. An electromotive force of 3·8 volts was employed in each test.

Distance between the centres of the plates, 90 centimetres.

Position of plates.	Galvanometer deflection.	Temperature.
V.	633	15° C.
	634	
	637	
VI.	660	15° C.
	655	
	651	

Distance between the centres of the plates, 20 centimetres.

Position of plates.	Galvanometer deflection.	Temperature.
VII.	403	15° C.
	368	
	358	
Battery reversed.		
VIII.	208	
	211	
	229	

Here again then the resistance is least with the plate end on even when the distance between the centres of the plates is as much as 80 centimetres.

The explanation of this apparent anomaly of the smaller resistance obtained when one or both plates is put end on is, as was pointed out by Mr. Boys, probably due to the smaller density of the gas which is deposited on a plate when it is put end on (in consequence of the current flowing from both sides of the plate into the liquid under these circumstances) more than compensating for the want of parallelism of the lines of flow when one or both of the plates are put end on.

NEW ATLANTIC CABLES.

WE published a brief note on this subject on the 7th inst., but the following particulars, which we extract from the *Electrical Review* of New York, will be read with interest, although some of the statements appear to be premature, particularly that respecting the manufacture of the cables. "Alderman Hadley, of London, after several weeks of negotiation in this country, has at length completed what he regards as most satisfactory arrangements for the laying and operation of a new cable line between England and America. The name of the new company is the American, British and Continental Cable Company, otherwise known as the 'A., B. C.' Cable Company. Its capital stock is £1,500,000, divided into 150,000 shares at £10 each. This has all been subscribed by English capitalists, who include some of the best-known and strongest financial men of England. The main office of the company will be in London. The objects of the association, as described in the articles of incorporation, are to establish communication between Sable Island and Belle Isle, and any other points that may be selected on the shores of the Dominion of Canada, and such points as may be chosen on the shores of Great Britain and the European Continent or elsewhere, and also between any points on the Pacific coast of the Dominion of Canada and Japan, China, Australia and India. Although this colossal scheme contemplates girdling the earth, for the present, at least, operations will be confined to cable laying between England and America. The extensive powers conferred on the company are derived from a special act of Parliament, which, in addition to granting authority to land cables at any point on the shores of the Canadian Dominion, gives the right to connect the same with the lines of the Government or any other telegraph company. The early completion of the Canadian Pacific Railway, and the consequent and natural increase in emigration and trade will afford, it is believed, a great amount of business for the new company, and is, in fact, one of the inducements that have been held out to investors in the company's stock.

"Two cables are proposed. One will start from a point to the north of Glasgow, Scotland, and land at Belle Isle, which is about 300 miles north of Heart's Content, Newfoundland, the landing point of the original Atlantic cable. By connection with the Canadian lines at this point direct communication will be established with every part of the Dominion. This will be known as the northerly route, and will be several hundred miles less in length than the southerly route, besides crossing no other cables. The southerly route will be established by laying a cable from Penzance, on Land's End, the most southerly point of England, to Sable Island, which is about 200 miles south-east of Halifax, Nova Scotia. From thence to the easterly end of Long Island will be laid a connecting cable, which will afford telegraphic communication direct between London and New York city. The land for the Long Island terminus has already been secured. The cables are now being manufactured at Henley's works, London. The work of laying them will begin in September next or the month following, and the company predicts that it will be completed during the present year. By a new process of manufacture, of which the company is the proprietor of the patent, the cost of the cable over the southern route is estimated at £650,000, including brokerage and every expense. The average cost of Atlantic cables has been about £1,600,000. The patent which enables the company to prepare so much cheaper a cable includes certain improvements by which copper wire of greater conductive power can be manufactured and a more permanent insulation secured. Landing rights have been secured by the company in France, Belgium, and Holland, and the company promises to furnish the public and the commercial world with facilities for rapid communication, such as are now afforded by no other company. In the articles of agreement which Alderman Hadley has drawn up between the cable company and the American Telegraph Company, with which connection is to be made, it is stipulated that no pooling of earnings or combination with other cable companies shall take place."

THE TELEPHONE SITUATION IN AMERICA.

THE recent extensive and rapid movement in telephone stocks, the tendency toward a concentration of the telephone interests of the country into a few large corporations, the rapid fluctuations in the prices of telephone shares and the frequent rumours of decisions in patent suits adverse to the interests of the present monopoly have led some of the daily journals to predict a crash in telephone stocks ere long, and to intimate that it may be as well for the lambs to stand from under. They compare the present boom in telephone stocks with similar activity heretofore in mining and other fancy stocks, and draw unfavourable conclusions. It is curious to note that, in the face of this, Bell telephone stock holds its own pretty steadily, and bids fair to reach the goal —300—toward which it has been tending for some time.

The rumour chronicled in our last issue, says the New York *Electrical World*, that the long-pending interference case in the Patent Office between the several pretenders to the priority of invention of the telephone, had been recently decided adversely to Bell, and in favour of Mr. McDonough, has produced a sensation in telephone circles. Perhaps those who started the report had no other object in view than to make certain persons so unhappy in their possession of too much stock that they might be induced to "unload" a little thereof, to the pecuniary advantage of the speculators. Tricks of this kind are not uncommon in Wall Street, and are sanctioned by numerous precedents in telegraphic and railroad stockjobbing. Meanwhile, having taken special pains to arrive at the truth in the matter, we learn that the rumour is only a rumour as yet, and an unwarrantable one at that. It is known that a decision has been rendered in the case, but everything that is reported as being the purport of the decision must be scouted as conjecture and speculation. The decision is known as yet only to the Patent Office authorities.* Even Mr. McDonough himself is still unac-

* We learn from what we believe to be a responsible source that the Examiner of patents in the United States Patent Office has decided that the Bell patent of January 7th, 1877, is an interference of McDonough's patent.—EDS. ELEC. REV.

quainted with the ominous secret which it contains. So he assures us personally. The decision is being printed, and will not be issued for some weeks. So we can calm our anxiety and hold on to our stocks a little longer.

An adverse patent decision would undoubtedly produce somewhat of a crash in Bell Telephone stocks, especially if it involved such a fundamental point as the receivers now used, without which telephony would be, if not impossible, at least very much hampered and beset with difficulties. An adverse decision would turn the tables and make it the defendant where it has always been the plaintiff, that is to say, in questions of infringement. If brought at bay by an injunction, it would be in a strait between infringement on one side and "no receiver" on the other. But only for a time. It owns the Edison "receiver," the principle of which is not involved in this decision. This receiver is not convenient, and above all not reliable, and for ordinary purposes it is not practical; but it can be made to answer as a makeshift in a case of emergency until something better has been procured. In such an event the public would be the real sufferers.

Look at it as we may, any construction that can be put on the scope of an adverse decision leaves the Bell Company good enough prospects. It has the advantage of a good start. No crash can come so overpowering that it will paralyse the present occupants of the field. They represent too much capital, and their prestige is too great for them to succumb to a competitor without a protracted struggle. We do not believe that they will fare worse after an adverse decision than did the Western Union Telegraph Company under the Page Patent Act.

There is a rumour that a syndicate is now systematically and vigorously, though quietly, at work to secure control of all patents and inventions outside of the jurisdiction of the Bell Company, with a view to making a bold competition with that company later. We cannot say how much truth there is in the report, but it is safe to presume that the hostilities are not yet ready to begin. An opposition company would promote a disposition on the part of such servants of the public to be more considerate toward their patrons. Competition is the soul of trade, and is a wholesome check on enterprises that tend toward monopolies. However, we should dislike to see an opposition company come into the field only to play a kind of a grab game, such as opposition telegraph companies have been playing at regularly recurring intervals on the Western Union Telegraph Company. The Bell Company has already bought up a good deal of opposition, and each acquisition makes it stronger, and only adds to the evil which the so-called opposition announced its intention of remedying.

NOTES.

Electric Lighting.—Mr. Hugh Watt, the managing director of the Maxim-Weston Electric Light Company (Limited), in a letter to the editor of the *Times*, dated the 20th inst., states that after mature consideration the board of the company had decided to abandon the company's City circuit pending the commissioners being in a position to allot off the City in large sections in terms of their advertisement of October last. Its reasons for so doing were solely based on the grounds of expense, as it was just as impracticable for an electric company to maintain a centre and staff to light a few streets as it would be for a gas company to do so profitably. For the information of its 1,400 shareholders he was pleased to be able to add that every City official with whom he had come in contact had expressed himself in satisfactory terms as to the company's lighting, and since it had substituted arcs for incandescents on Pentonville Hill, the vestry had also been pleased to express their entire approval of that installation. We suppose, therefore, that by the time the ELECTRICAL REVIEW meets the eyes of its readers this week, the Brush system will probably be the only one left of the three which had certain portions of the City allotted to them for the purpose of trying the electric light as an illuminant for streets. That this result means the survival of the fittest is by no means the case, but simply that the two competitors, the one retired, and the other retiring, have been working at a great loss. Whether the remaining company will follow the same course, or whether it will light the streets vacated by its rivals remains to be seen. Apparently, there is not much profit to be gained in street lighting either by electricity or gas, and as the electric light has not yet advanced to that stage in which it could compete in cheapness and reliability with gas for household purposes, it really appears a waste of money to keep up an extensive establishment simply for the sake of illuminating two or three streets for a given number of hours per night.

At the weekly meeting of the Metropolitan Board of Works on Friday of last week the Parliamentary Committee brought up a report in reference to the memorials of the Vestry of Hampstead and the Poplar District Board regretting that the Board of Works had petitioned against the provisional orders for the electric lighting of Hampstead and Poplar respectively, in which it was stated that the Board had resolved that counsel should not appear in support of the Board's petitions against the orders in cases where the local authorities had agreed with the promoters. This having been taken to mean that the Board did not wish the petitions to be proceeded with, the committee had to report that all the petitions had been withdrawn, and that the only action to be taken on behalf of the Board would be to endeavour to obtain the insertion of such provisions as may be necessary for the protection of the Board's sewers and other works. The report was adopted.

At the Parkes Museum of Hygiene, Margaret Street, Regent Street, Captain Douglas Galton lectured on Thursday night of last week upon "Recent Improvements in Artificial Lighting, and their bearing upon the purity of air in rooms." Dealing with the different systems of electric light, he said the arc light, with its dazzling brightness, was subject to fluctuations, from the fact that the carbon points were continually wearing away and the constant necessity of shifting them rendered the light often unsteady. Further, it was not pleasing in colour, and it had been alleged against it that it produced a great quantity of nitric acid. In the incandescent light the electric current was employed to heat the carbon, so as to make it incandescent, and thus use it as a source of light. He remarked in conclusion that the electric light would probably supersede all others, but it was probable that the great advance which had been made in illumination by means of gas might enable that material still to hold its own for some time longer. Sir Joseph Fayrer, speaking in the course of a brief discussion which followed, agreed with the view expressed by the lecturer that the electric light was the light of the future. He looked with horror upon the present abominable condition of nearly all theatres and public buildings, and remarked that it could not but be expected that people should look for another and a better form of light than that at present in common use.

The strong opposition which has been shown by the ratepayers of Newington to the scheme for lighting about three-quarters of a mile of the parish with electricity has induced the Local Government Board to make an official inquiry into the circumstances of the case, and on Saturday last Major Marindin, representing that department, opened the inquiry at the Vestry Hall, Walworth Road. The vestry clerk said it was proposed to borrow £20,000 to carry out the scheme. The principal opponents of the scheme were the owners of small property. The latter body admitted that they had paid canvassers a halfpenny for each signature obtained against the scheme, the total reaching £22. A vestryman named Smith (a cabowner and driver) stated that the opinion of the people with whom he came in contact was that "Electricity produced a fine light while it lasted, but when it popped out they were all in the dark." Major Marindin intimated that he should make his report to the Board of Trade.

A number of the shopkeepers of Quebec have made arrangements for the lighting of their premises by electricity from August next.

The Kirkcaldy Floor Cloth Mills, Cathhead, are to be lighted by electricity.

In the course of evidence given on Monday by Mr. Farrer, secretary of the Board of Trade, before the Select Committee of the House of Commons on Electric Lighting, the question of the lighting of several of the metropolitan

theatres arose. By Provisional Order, No. 8, the Board of Trade empowered the Swan Company to light the Strand District, subject to a proviso in Clause 67, enabling the Jablochkoff Company, on obtaining a licence, to supply a portion of the district. To this provision objection was raised by counsel on behalf of Mr. Irving, of the Lyceum Theatre; Mr. Hollingshead, of the Gaiety; Mr. Harris, Drury Lane; Mr. D'Oyly Carte, Savoy; Miss Ada Cavendish, Sir Arthur Sullivan, Miss Swanborough, and others. Mr. Farrer, in reply to Mr. O'Hara, agreed that persons engaged in theatrical pursuits have great and deep interest in the proper lighting of their district, and were the most important consumers. It was also important to them that they should be no worse off than their competitors. Asked if he did not suppose managers of theatres would be unwise to alter all their arrangements on the faith of a seven years' licence, he said he would rather not answer the question. He had been at the Savoy Theatre, and though there were other persons as well qualified to judge as he was, he liked the light. Asked on behalf of the Jablochkoff Company if he had seen theatres in Paris lighted by that company, he said he had not. It was understood that further evidence will be given on the subject.

In the House of Commons, on Wednesday, on the Order for the third reading of the Electric Lighting Provisional Orders (No. 1) Bill, Sir G. Campbell said he did not wish to oppose the Bill, but he thought there ought to be some method by which hon. members might ascertain what amendments were made in Bills which came before the committee as unopposed measures. He understood that the greater part of the metropolis had been handed over to the Metropolitan Brush Company. That company had some £100,000 capital, of which three-fifths was paid-up, but he understood that a great portion of that money had been spent in promotion and other expenses. The Bill was read a third time, as were also the following Electric Lighting Provisional Orders (Nos. 4, 6, and 11) Bills. On the Order for the consideration of the Electric Lighting Provisional Orders (No. 7) Bill, Sir G. Campbell again complained that hon. members could not ascertain what amendments were made in the Bill. Sir G. Balfour suggested that the Provisional Orders should be presented separately, so that those interested might be able to get them without having to purchase the bulky Bills, as at present. Mr. Chamberlain said the subject had been under consideration, and arrangements had been made to supply the Provisional Orders separately at a small cost to people interested.

The Electric Lighting Act.—A Parliamentary paper has been issued containing the report of the Board of Trade respecting the applications to and proceedings of the Board under the Electric Lighting Act of 1882. From this statement it appears that by the 21st of December last, the date prescribed by the rules which the Board of Trade had issued, 106 applications had been received. Twenty-three of these were promoted by local authorities, and 83 by companies; 97 of the applications related to places in England and Wales, eight to places in Scotland, and one to Belfast, Ireland; 35 related to London and the suburbs. A list of the applications is given in an appendix. A fee of £50 was received with each application, and in 10 cases where separate orders have been granted for various districts included in one application, an additional fee of £10 has been charged by the Board of Trade. The total amount of fees received amounts to £5,400. The time for lodging objections was limited by the rules to two months from the date of the first advertisement of the application. It was, however, extended by a new rule to the 1st of February. Eventually, after a consideration of the orders as deposited, and of the objections which had been lodged against them, the Board of Trade determined upon the principles upon which the applications should be dealt with, and on the 28th February they circulated model clauses for adoption with such modifications as might appear to be necessary. The charges to the public are more than covered by the fees received. The report is supplemented by several appendices.

News Agencies and their Telegrams.—In reference to the case of the Central News *v.* The Eastern Telegraph Company, with regard to telegrams from Egypt, which was heard before Mr. Justice Lopes and Mr. Justice Williams in the Queen's Bench Division of the High Court of Justice on Thursday of last week, and reported in our last issue, Mr. A. M. Sullivan, the plaintiff's counsel, did not say, as stated, that the Examiner "had referred the matter to the court in order to avoid any dispute hereafter;" but that the Examiner decided in favour of the plaintiff's claim for Mr. Burleigh to be present at a preliminary inquiry. The appeal, which was dismissed, was against this decision.

New Cable.—The cable from Saigon to Bangkok was opened on the 14th inst.

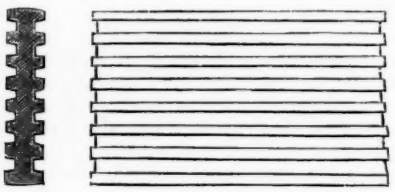
Laying of a New Cable.—The Telegraph Construction and Maintenance Company's steamer *Scotia* paid out up to noon on the 23rd inst., 205 knots of telegraph cable from Vladivostock towards Nagasaki.

The Wimbledon Electric Railway.—One of the features of last Saturday's Wimbledon rifle meeting was the running for the first time by the Electric Motor Syndicate Company of an electric tramcar on the line laid by the National Rifle Association to carry visitors from the flagstaff to the distant ranges at the Wimbledon end of the common. The current, which was supplied by a Maxim-Weston dynamo machine, was carried down the centre of the line by copper leads. The motor, attached to one end of the car and enclosed in a box about 30 in. square, was that patented by the company, and the current is said to have been communicated to it by a "contact Brush car," running along the copper leads attached to the car, and connected by flexible insulated wires with the motor.

The Amendments in the Patent Bill.—The Bill, as amended by the Standing Committee, has been reprinted, ready for presentation to the House. In its new form the part of it relating to patents for inventions shows many important alterations, though in details only, the amendments having scarcely touched any of the main principles of the original measure. The improvements which have been made are for the most part due to the efforts of committees of the Society of Arts, the British Association, and the Institute of Patent Agents, all of which bodies had interviews with Mr. Chamberlain. As regards the method of application for patents no great changes have been effected in the original scheme. Provision is made for joint application by several persons, of whom one or more may be the actual inventor, and the rule that the provisional specification was to contain precise claims has been struck out. The proposed system of examination into applications has been modified in several particulars. The examiners are to report if they find two applications for protection for the same invention, and in such a case both applicants are to be informed. Provision is made for the keeping secret of the examiners' reports, even in the case of an action at law. The provisions for opposition to grants of patents are the same as in the original Bill, but opposition is limited to two grounds (1) that the person opposing has been robbed of the invention; (2) that there already exists a patent for the same invention. It will be noted that this last provision practically opens up the whole question of novelty, and might enable a rival trader to force an applicant to defend the novelty of his invention in its very earliest stages. In the case of a capitalist pitted against a poor inventor it is easy to see the hardship of such a proceeding. No changes are made in the fees, but an alternative scale is given under which they may be paid annually. This scale is so arranged that a patentee whose patent lapsed at the seventh year period would pay slightly less in annual fees than if he paid a lump sum in advance. The practice of "racing for the seal," as it is called, that is, the attempt by a later applicant to get his patent sealed before an earlier applicant, and, therefore, effective against him, is clearly done away with in the amended Bill. A new clause has been introduced rendering patents effective as against the Crown. In the section devoted to legal proceedings there is inserted a new clause providing a remedy for groundless threats of such proceedings. In the miscellaneous section also there are one or two fresh clauses. Among these will be found provision for the case of an inventor who dies

without applying for a patent, while another sub-section instructs the Patent Office to keep on sale copies of specifications of all existing patents. One more provision there is of considerable importance. In case of international arrangements being effected for the protection of inventions, a foreign patentee is to have priority over other applicants if he applies within six months of the date of his foreign application. This rule is, however, only to apply to foreign States with which international arrangements have been made.

Carbon Plates for Batteries.—The illustration shows a form of plate brought out by Mr. R. Applegarth, by which the surface, for a given size of plate, is very much increased. Other specimens have the corrugations cut through at intervals so that the liquid of the battery may circulate



through and around the plate. We would suggest that Mr. Applegarth should devote some attention to the improvement of the metal plates of batteries, as this is one of the points in which inventive ability could be most usefully employed.

Forged Telegrams.—It is stated that on Monday morning a large number of forged telegrams, purporting to be sent by Dublin stockbrokers, were forwarded to brokers in London ordering the purchase and sale of large quantities of stock. Fortunately some circumstances occurred in London to arouse suspicion, and the consequence was the telegrams were not acted upon. An inquiry has been instituted, but as the messages were hand printed it will be probably difficult to trace their authors.

Telegraphic Extension.—The telegraph has been extended to Whiting Bay, Arran, under a five years' guarantee of £31 per annum.

Telephones.—For the sum of 5s. annually the Police Commissioners of Perth have given to the National Telephone Company (Limited) permission to erect a wire from the Perth offices of the Scone Preserve Works to Scone.

Brooks' Underground System.—The laying of the underground conduits of the Brooks' system was begun on June 28th, on Front Street, above Market, Philadelphia, and when completed will extend to the Kensington Depôt. In order not to interfere with the traffic on the streets, the conduits are to be laid in sections of 2,000 feet each, so that the street can be repaired at once. Our readers are aware that this system has been successfully employed by the Post-office authorities in London.

Telephoning Through Submarine Cables.—An experiment in cable telephony was made on June 10th by Messrs. Theodore N. Vail, of the American Bell Telephone Co., W. H. Eckert, J. A. Seely, both of the Metropolitan T. & T. Co., and Mr. Ladd, of San Francisco, Cal. Five submarine cables, each one mile in length, crossing the North River between New York and Jersey City, were connected together, making a total length of five miles of cable. This was placed in circuit with 106 miles of aerial wire, making a total of 111 miles. Conversation was carried on with the greatest ease, and without the least interruption from induction or retardation. In the experiment Blake transmitters, with two cells of battery for each, were used, in connection with Bell receivers. We should scarcely expect much interference from such a short length of submarine line, more especially if the cables had only single conductors. If they were multiple, and other working was going on at the time these experiments were made, no doubt the result would have been somewhat different.

The Louisville Exhibition.—We learn from American sources that the contract for lighting the Louisville Exhibition building has been awarded to the Edison Electric Light Company, of New York; that 4,600 Edison incandescent electric lights of 16 candle-power each will be employed. The Exhibition is the largest building ever lighted by electricity. The amount of copper wire used will weigh 40,000 pounds, and if stretched out would reach 40 miles. Some of the wire is very thick. There will be 15 dynamo machines worth about 4,000 dols. each. To actuate them 4 Armington and Sims engines and one large Reynolds Corliss engine will be required, the latter being furnished by the exhibition company. The plant will cost in all about 100,000 dols.

The First Electric Locomotive.—A writer in the Baltimore *Sun* recalls the experiments of Dr. Charles Grafton Page, who, it is said, constructed an electrical machine when only ten years of age and graduated at Harvard University in 1832. In 1838-40 he practised medicine in Virginia, and 1839-40 filled the chair of Professor of chemistry in Columbia College, in the District of Columbia. In 1840 he was appointed Examiner at the United States Patent Office, which office he held until his death. He was a frequent contributor to *Silliman's Journal*, and is the author of a concise and complete treatise upon the subject of electrical science and discovery. He had been for years perfecting machinery for the effective and economical use of electro-magnetism as a motive-power, and had so far succeeded as to be able to use it for the propulsion of machinery, and as a locomotive force. In 1851 he constructed at Washington a locomotive to run by electricity, and at its first trial, on April 29th, of the same year, on the Washington Branch of the Baltimore and Ohio Railroad, it more than exceeded the expectations of the inventor, though many difficulties were encountered in matters of detail. The trip was made from Washington to Bladensberg in 39 minutes, including five stops, and the greatest speed attained was at the rate of 19 miles an hour.

Cutting Electric Light Wires.—We read that the City Electrician of Chicago has declared war against certain of the electric light companies in that city by cutting all the wires not placed underground. The competition has become so sharp between the companies that it is said that they do not use properly insulated wires, and that they string them at random on the house-tops, where contact with them would result in instantaneous death. A number of wires have already been cut. This action has reference to arc lights only, no danger being apprehended from wires used in the transmission of currents for incandescent lighting.

Electrical Transmission of 31 Effective Horse-power.—A remarkable experiment upon two Gramme machines of novel construction was made last Saturday, at the workshops of the Compagnie Electrique. This experiment, says the *Bulletin de la Compagnie Internationale des Téléphones*, was made in the presence of M. Tresca, M. Potier, and M. Hippolyte Fontaine. The power employed to turn the generator was 48 H.P., the receiver developed 31 H.P. at the brake, and the speed of the generator did not exceed 660 revolutions per minute. We cannot gain any information as to the coupling up of the machines, resistance in circuit, or any technical details.

The St. George Telephone Company.—We understand that licences have been granted to this company for London, Liverpool, and Manchester.

The Underground Wire Question.—Mr. James Greenwood, of Bacup, writes to us giving an estimate for the cost per mile of insulating twenty-four ordinary telegraph wires with his Patent Silicite Compound, including cost of creosoted troughing in which the compound and wires are placed.

33 tons of Silicite Compound at £5 10s. per ton ...	£181 10 0
1,760 yards Troughing at 7d. per yard	51 6 8
	£232 16 8

being at the rate of £9 14s. *per wire per mile.* The cost of insulating the same number of wires under the present

system, says Mr. Greenwood, is not less than £1,000 per mile for material, thus showing a *saving* of £800 *per mile*. Mr. Greenwood continues, "You can draw your own conclusions as to the feasibility of placing all electric wires underground from the above statement." We do. We may add, in conclusion, that Messrs. Shippey Brothers are the representatives of Mr. Greenwood's invention.

The Distribution of Electricity.—The National Company for the distribution of electricity by "secondary generators," or, in other words, by the induction coils of Messrs. Gaulard & Gibbs, has issued a pamphlet describing a project for lighting the Suez Canal by electric incandescence lamps. We have on several occasions referred to the apparatus claimed by these gentlemen. It is proposed to place along the entire length of the canal secondary generators capable of producing currents for lighting incandescence lamps of 80 to 100 candle-power, but at the stations it is intended that Jablochkoff candles should be employed. The lamps for the canal would be placed on alternate sides at every 125 metres, so it will be seen that the object is rather to mark the channel than to light the canal. 1,280 incandescence lamps is the requisite number, and the primary current is to be of 40,000 volts and 16 ampères, furnished by four dynamo machines of 10,000 volts each, consuming 850 H.P. The transmission of the primary current is to be made on a single cable formed of 18 wires, No. 19 B.W.G. The length of submarine cable to be employed is about 80 miles, and the land wire 90 miles. These are estimated at £250 and £95 per mile respectively. The engine-power and dynamo machinery is to be duplicated, and the total cost of the installation is estimated at £81,750, and the annual expenditure for maintenance £10,000. We should like to see the proposed 10,000 volt machine (alternating current) in action, and to note the result; and also to know whether the company's chief engineer, M. Gaulard, has given any attention to the insulation necessary for his primary cable which is to withstand the E.M.F. of 40,000 volts. The pamphlet, as a whole, shows a marked want of forethought and contains a deal of twaddle.

Edison and Swan Combination.—We hear that the scheme for combining the interests of the two companies owning respectively the above systems is completed, only the signature of one prominent individual in America being awaited to conclude the agreements. Are we to have the threatenings over the use of carbon in lamp filaments as well as over carbon in telephone transmitters? Any such attempt will, we hope, meet with the prompt snubbing it deserves.

Long-Distance Telephoning.—The shareholders of the United Telephone Company are to be congratulated in having a chairman with such depth of scientific knowledge. In speaking of telephony he said the wonderful feat of conversing between New York and Chicago—1,000 miles—had been accomplished by the instruments of which the company held the patent rights, viz., the Edison transmitters and Bell receivers. These instruments would also talk over any number of miles in this country, and, provided perfect insulation be obtained conversation could be had over unlimited distances. As perfect insulation cannot be had for love or money, and as there are certain other drawbacks doubtless familiar to the worthy chairman to be overcome before long-distance telephony becomes commercially successful, it may be that by the time unlimited distances are spoken over the Edison and Bell patents will have become public property.

Telegrams.—The *Times*, commenting on the report of the Postmaster-General for the year ending 31st March, after alluding to the steady development in the circulation of letters, says:—When we turn to telegrams, we do not find the same evidence that the present system reaches the mass of the people. The number of messages sent is only 32,000,000, and the increase was little more than a third of that of the previous year. The proportion of telegrams to letters is not stated in the present report, but last year it was put at 1 to 44; while in the case of France it was 1 to 29; in Belgium, 1 to 24; in Holland, 1 to 22; and in Switzerland, 1 to 23. Bearing in mind the much larger correspondence of this country, as indicated by the figures we have just now quoted, the small use of the telegraph here as compared with the Continental countries shows that the service is of a far less popular character. It is to be hoped that the promised reduction of the *minimum* charge to 6d., to which Mr. Fawcett alludes, will redress this anomaly in the postal system.

Strike of American Telegraph Operators.—At noon on Thursday of last week, 375 telegraph operators struck work at New York, and their example was followed at Chicago, Washington, Baltimore, Cincinnati, Philadelphia, Boston, and other places. The average monthly wages of telegraph operators in the States is 54 dollars; in Canada it is 37 dollars. Their demands are equivalent to an advance of from 25 to 75 per cent. Their ranks have been daily recruited and they claim now to number 17,000. The following is a statement of the number of operators on strike and at work for the Western Union Company in the chief cities:—New York, 375 have struck, 160 are still working, and by calling in operators from the suburban branch offices this number has been increased; Philadelphia, 155 have struck, 93 are working; Baltimore, 65 have struck, 30 are working; Boston, 30 are working, and 100 have struck (this district having suffered in proportion the most severely of all); Washington, 20 have struck and 20 are working; Pittsburg, 29 are working; Chicago, 100 have struck and 90 are working; Milwaukee, 60 have struck and 20 are working; Cincinnati, 50 have struck and 30 are working; at Providence there has been no strike; Indianapolis, 30 have struck, 18 are working; Buffalo, 28 are working—two-thirds of the full force; St. Louis, 54 have struck and 65 are working; Toronto, 60 have struck and 30 are working; Detroit, about half the total force of operators have struck; New Orleans, 37 have struck, 10 are working. There has been a general rally to the company's support by former operators who had sought other occupations, and so much efficient aid being thus received from outside, it is believed the strike must fail. At a meeting held in New York on Monday the chief of the Wheatstone operators, a number of whom are on strike, announced that he intended proceeding to England in the autumn, and that there would probably be a strike in that country, as the telegraphists there were miserably underpaid, and were organising an association with this view. The telegraph companies assert their ability to defeat the strike, but the operators declare the contrary, they receiving financial aid from the lodges of the Knights of Labour throughout the country. The New York Produce Exchange will, it is said, endeavour to arbitrate between the companies and the operators.

CITY NOTES, REPORTS, MEETINGS, &c.

The Direct United States Cable Company (Limited).

THE twelfth ordinary general meeting was held at the Cannon Street Hotel, on Thursday, Mr. John Pender, M.P., the chairman of the company, presiding.

The Secretary, Mr. J. W. Fuller, read the notice convening the meeting, and the directors' report, which we published in our last issue, having been taken as read,

The Chairman said before asking them to approve of it he wished to refer to some figures in the report so that they might thoroughly understand and appreciate it. The revenue for the half-year ending 30th June last, after deducting outpayments, amounted to £70,529 19s. 5d. and the working and other expenses for the same period, including interest on debentures and income-tax, to £19,315 8s. 9d., leaving a balance of £51,214 10s. 8d., as the net profit for the half-year, making, with £1,286 16s. brought forward from the previous half-year, a total of £52,501 6s. 8d., which had been distributed as follows:—Interim dividend for the quarter ending 31st March, 1883, £15,177 10s.; proposed final dividend, £15,177 10s.; transferred to the reserve fund, £19,877 17s. 3d.; depreciation of spare cable tank at Halifax, £416 1s. 6d.; balance carried forward, £1,852 7s. 11d.; total, £52,501 6s. 8d. The company's revenue was larger by about £9,500 than in the corresponding period of 1882, but owing to the different tariffs in the two half-years and to the operation of the joint traffic agreement of May, 1882, these figures afforded no reliable comparison; but comparing the Atlantic traffic as a whole with that in the corresponding period of 1881, when similar tariffs were in force, there was not only no increase but a slight reduction during the past six months. The expenses in London remained practically the same as in the same period of last year. The expenses at stations showed a reduction of about £2,550, owing to their new arrangement on the American side. That reduction might not be maintained, but every effort would be made with a view to its continuance. The remaining

items of expenditure called for no special remark. The reserve fund had been increased by the transfer of revenue and by interest on investments to the sum of £315,000, and the present value of the company's investments was considerably in excess of the amount of their cost to the company. That was a very satisfactory state of affairs looking to the times which they had passed through, and more particularly to the present time when there was such a depression in trade, not only in this country but in America. He was told the other day by a very old-experienced operator on the Stock Exchange that he never remembered but once in the period of a long life such a state of stagnation as that which existed at the present time. Now, he had found in his experience of telegraphy that it was about the best barometer of trade that existed. When trade was active, telegraphs were freely indulged in. It was a grand luxury in commerce. It was at the beginning and at the end of almost every operation. Taking the state of trade and everything altogether, however, he thought they had reason to congratulate themselves on the position they occupied that day. When he addressed them six months ago, his remarks were pretty much the history of telegraphy for years past, and they covered the ground that day. He therefore did not intend to inflict on them such a speech as he then made, but when he last addressed them they had just opened an independent submarine telegraph office at New York, and he was now glad to say that it had not only been a marked, but a signally marked success. Human nature was the same all over the country. People liked two strings to their bow, and now that there was a considerable amount of custom in America, on account of the strike of telegraph operators, he was glad to find their office had improved enormously in value in keeping up, without interruption, communication between America and this country. The other companies had done their part; they had done it well, but at the same time their company was entirely and completely independent of the Western Union system, and therefore they were not subject in the slightest degree to be controlled by the Western Union, and the Western Union hands were the hands on strike. He had felt strongly the advantage of having an independent office and also that a monopoly of anything was not a pleasant and acceptable system. They had only the other day had the most marked expression of public opinion against monopolies that had occurred in modern times. He had heard it said that their telegraph system was a great monopoly. He denied it; it was no monopoly. There were four different companies carrying on telegraphic communication between the old and the new world, and three distinct companies carrying on similar communication with India and the far East. These gave people an opportunity, if they were displeased with the one system, to take up another; but he held at the same time that they were bound to see that the public got a thorough, efficient, and good service, and looking to the continuity which was necessary in conducting telegraph enterprise, it was an absolute necessity that the companies who were operating should have a perfect understanding with one another, so as to thoroughly carry out the system in its efficiency, and thereby benefit the public and not destroy the interests which the shareholders were fairly entitled to. Those were his opinions upon the way in which improved enterprises like that should be conducted. He believed they had conducted that enterprise on a very sound policy, and he thought, when one looked back to the very few years of that company's existence, to the reserve accumulated and the percentage given during these years, that there was no reason for regret, and they believed that while they had benefited the shareholders they had also benefited the public. As to the future of telegraphy—it was now still in its infancy—he believed it would be the pioneer of trade, that trade would be largely increased and benefited by telegraphic communication, and with these views he thought they might congratulate themselves on holding a sound property. If it was conducted with wisdom and judgment, it might command the respect and attention of the great body of the public. (Applause.) He concluded by moving that the report of the directors and the statement of accounts be adopted, and that a dividend be declared of 5s. per share, free of income-tax, making, with the three interim dividends, 5 per cent. for the year, being a total distribution of £60,710.

Mr. W. Ford seconded.

Mr. Newton drew attention to a company which, he said, was being promoted by a gentleman who was expected to be the next Lord Mayor of London.

The Chairman said the fact was he attached so little importance to the movement referred to that he did not think it worth noticing at a meeting like that; but as Mr. Newton had referred to it, he thought he might simply say that interests large and important had paused before going into such a transaction—to lay cables where cables were not required—and he believed the next cable, if a cable came, would come from a very different quarter from that to which Mr. Newton had alluded, namely, from Mr. Garrett and other men of real power and influence. He believed there was no backbone in the one, but that there was backbone in the other; but at any rate they were in a position at the present moment to beat anything that came against them.

The report and accounts were then unanimously adopted.

Mr. E. M. Underdown, in moving that the chairman be re-elected a director and chairman of the company, highly commended Mr. Pender on his indomitable perseverance and extraordinary energy, which, he said, had tended not only to the prosperity of that company, but to the prosperity of that in which he took so lively and thorough an interest, namely, telegraphy in general. When the history of telegraphy came to be written he believed the name and doings of the chairman would be the subject of one of its largest chapters (hear, hear).

Mr. C. J. Gunther seconded, and the motion was unanimously adopted.

The Chairman, in returning thanks, said he believed, as he had already told them, that telegraphy had yet a great work to do, and he was very proud, and should always be proud of the way in which his name had been more or less associated with it.

Mr. E. M. Underdown was, on the motion of the chairman, seconded by Sir Henry Keppel, G.C.B., D.C.L., re-elected a director of the company.

Mr. John G. Griffiths and Mr. John Sawyer were re-elected auditors.

A vote of thanks to the chairman and directors closed the meeting.

The United Telephone Company (Limited).

THE third annual ordinary general meeting was held at the Cannon Street Hotel on Tuesday, Mr. James Brand, the chairman of the company, presiding.

The managing director (Mr. J. B. Morgan) having read the notice convening the meeting,

The Chairman said: I have now to move a resolution that the report and accounts be taken as read, and be received and adopted. When I took leave of you last year I hoped that we might have a peaceful time before us which might assist us in developing our business and in beginning to acquire the fruits of our labours. The entire contrary has, however, been the case, and I may say that during the whole of the past half-year we have not had one month free from worry and anxiety and trouble. We have not only had constant fighting with infringers, who seek to reap the harvest we have sown, but we have again had to fight one of the most determined battles in the Court of Appeal, in the defence of our property, which has ever been fought in this country. Of this fight and our previous fights we have kept you fully informed by circular from time to time, but there is one of which you have not heard that I think I ought to say a few words about, as had we not won it, or virtually won it, it would have been rather a serious matter for us. It happened in this wise. You will remember that in May of last year, Mr. Justice Fry decided an action brought by us against Messrs. Harrison, Cox-Walker and Co., in our favour upon all points except a technical objection to the effect that as we had included in our patent the invention called the phonograph, which was not included in our patent specification, our patent was void until we disclaimed the phonograph, and this the Attorney-General gave us leave to do. We took the necessary steps in this matter and the disclaimer was granted in August, 1882, nearly three months after our application, and in this delay lay the great danger to which we were subjected by Mr. Justice Fry's decision, for during the interval between the decision and the granting of the disclaimer all telephones under the Edison patent that were manufactured or contracted to be manufactured by your company might have been protected by the fiat, of the Attorney-General. Our opponents claimed before the Attorney-General to have protection for 800 Blake transmitters and something like 8,000 instruments called Hunnings. The result of this attempt to obtain protection for all the telephones alleged to have been *bonâ fide* contracted for was that only the 800 Blake transmitters were protected and the company being the owners of the Blake patent have been able to prevent the use of these instruments. The remainder of the instruments claimed to be protected were held by the Attorney-General not to have been *bonâ fide* contracted for; and this can hardly be an agreeable reflection for those gentlemen who were so ill-advised as to bring forward this rather outrageous claim. I think we may congratulate ourselves on this termination of a matter that might have turned out inconveniently to the United Telephone Company. With these explanations I think I have said enough as to our legal position. It has been said that we spend a great deal of money in law. This is unfortunately true, but it is impossible to help it. It is also said we go to law to create and maintain a monopoly. This is not true. We should be glad, of course, to have a monopoly if we could get it, but the Postmaster-General has effectually provided against such a contingency. But if we cannot have a monopoly of telephone business, at any rate we have a right to monopolise our own instruments that we have bought and paid for, and that is the reason we go to law. We go to law for the same purpose as a householder bars his doors at night—to prevent his house being broken into by burglars and his property removed. Now I come to the report. I do not think I need say much as to the actual expenditure and revenue—the figures speak for themselves. The large increase of the revenue in return for the sum expended in capital must, I think, be satisfactory to you. I think also we may fairly congratulate ourselves and the managing director that this large increase of revenue has been earned with a moderate increase in the working expenses. As to depreciation, we have made ample allowance on that score, and we continue to reckon that the large interests in shares which we hold in our subsidiary companies, which are not taken into our accounts, as far as profit and loss are concerned, are more than ample provision for any decrease, if any, in the book value of our patents. As a matter of fact, these shares are growing in value every day. Both the Lancashire Company and the National Company have each an annual gross income exceeding £50,000 a year, and are most valuable auxiliaries in the development of the telephone enterprise in England and Scotland. The Irish and Northern Company's business is also steadily increasing. Now as to the dividend; it is not yet a very large one, but as I said last year, when we declared our modest five per cent., it is honestly earned. We might have paid you something more, but we thought that it was safer and that you would be better satisfied if we erred on the side of caution, carrying forward a safer balance for any contingencies that may arise next year. As to the issue of capital we shall want some more money as our business increases. We want to repay our reserve what we have spent out of the capital account. The £2 premium with the balance carried forward will more than pay this, and any further increase in market value of our shares we think it right the shareholders should benefit by. The figures to the 30th April are before you, and since then we have opened the Millwall Exchange and an exchange in Edgware Road, and one or two others are on the point of being opened, but in regard to them we have not yet

arranged with the Post-office authorities. There are fresh subscribers coming in every day, and yesterday, I am glad to tell you that, after surmounting very great difficulties electrically and otherwise, I had the pleasure of speaking through our telephone for the first time to the House of Commons. I think in a very few days the full advantages of our system will be placed at the disposal not only of the members of both Houses of Parliament but also of the public engaged in parliamentary business in the committee-rooms, and I think this cannot fail but to act in the shape of a very excellent advertisement for us (hear, hear). We think we have made good progress, but some of you may think we might have done more during the past six months. I do not know whether we could or could not, but it has not been for the want of trial. You must remember that we are making good our ground as we go along. We are making our centres good, and are slowly and surely pushing out to the suburbs, and in this direction we hope to have more to tell you next year. We must not compare the circumstances which surround us here with the circumstances which surround the telephone in America, where its use has become a necessity of daily life. Here, I can assure you, we still find it difficult to impress upon people that they cannot and ought not to live without the telephone, and the development of our business is daily accompanied by worry and anxiety and constant irritation. One of the greatest of these sources of irritation, as far as I am concerned, is the fact that I know that many of our shareholders will not even help our own interests forward by becoming our subscribers. I think I am surely entitled to ask for your aid in this matter. As to the Post-office authorities, our relations with them are very friendly indeed, and I hope they are beginning to look upon us, not as opponents in telegraph business, but as valuable assistants and contributors to the revenue of the department through our rapidly increasing royalties. I think I have now touched on all the subjects in the report. As to the future, I can only say I believe telephony is only in its infancy, as far as this country is concerned, and I am sure before very long you will have your houses connected by telephone with your places of business. I have had mine so connected for a long time past. As stated in a circular we issued some time ago, a conversation was held by telephone between Chicago and New York, a distance of 1,000 miles. This wonderful feat was accomplished by us by the instruments of which you hold the patent rights—by the Edison transmitters and the Bell receivers. You will find yourselves that your instruments talk over any number of miles in this country. Provided perfect insulation can be obtained, conversation with your instruments can be had over unlimited distances, and we are only waiting for the completion of some experiments we are carrying out to carry our lines to Brighton, Birmingham, Manchester, and Liverpool, and from all these places we have considerable offers of business. I do not know I have anything more to say. I have touched as fully as I can on all the points that have occurred to me, but I shall be delighted to answer in the fullest possible way any question that any shareholder may ask. I cannot sit down, however, without paying my public thanks, and the thanks and gratitude of every one of my colleagues, to our most excellent friend the managing director, Mr. Morgan, for his untiring zeal and his intense devotion to the interests of all of us. I conclude by moving that the report and accounts be taken as read and received and adopted (hear, hear).

Mr. J. S. Forbes in seconding the motion called the attention of the shareholders to the evidence which the accounts of that year showed of the increased use of that most wonderful invention, the telephone. The difficulties under which the concern laboured were very great. One of the most difficult things in the world was to teach people something for their own benefit, and in this country people were notoriously slow to learn. He had some figures, however, which would show that the effort on their part to teach had not been thrown away. The highest number of calls on any one day was reached a few days ago, which was 22,253. To show the calls comparatively he might mention that during their first year's operations they numbered 943,831, in the next year 2,313,033, an enormous progress, and in the past year the number had been double that of the preceding year, being 4,698,422. The total number of their exchange subscribers that day was 2,899, and he had no hesitation in predicting, although prophecy was a bad game, that the extended knowledge of the telephone would lead to a largely increased number of subscribers. So much as regarded the exchange. Another source to the revenue of the company was what was called private wire business. These wires were progressing in a very satisfactory way. From them in 1881 they derived £2,988, in 1882 £4,370 and in 1883 £9,402, or more than double that of the preceding year. He himself was the happy possessor of a private wire for which he paid what appeared to him a moderate sum, and if the sum were doubled or trebled he could not afford to dispense with it, and every one who secured a wire would agree with him in time. In regard to the dividend, he thought on reflection any one who had anticipated a larger dividend would see the wisdom of the board in keeping that disbursement to the moderate and yet not unhandsome sum of 6 per cent. Mr. Forbes concluded by alluding to the admirable manner in which the chairman and their managing director had worked for the company.

The Chairman said, in alluding to their managing director, he should also have mentioned the skilful and most devoted staff of assistants they had in their employment. He could not speak too highly of the devotion and loyalty of their staff to their interests. (Hear, hear.)

Mr. Goldsworthy was exceedingly glad the dividend was to be only 6 per cent. Theirs was a progressive dividend, and it was better that in that stage of the company they should not run the risk of wrecking the company by overstretching the dividend. He considered the directors had acted very fairly in the new shares they were about to issue. One difficulty they would have to contend against in the future would be that of overhead wires, but by the time it arose he hoped the telephone would be an institution in the country, and that the Government would be able to assist them. On the whole, he was one of those who thought, after a careful examination of the accounts, that the report was exceedingly satisfactory, that they had everything to congratulate themselves upon, and that they might cordially agree with the motion.

In reply to shareholders,

The Chairman said their business was increasing in the country as well as in London. The Lancashire and Cheshire Company was the only company from which they had derived any dividend. In the National Company they were only deferred shareholders after the 6 per cent. That company, he considered, was prospering very well, and he thought in it they were within sight of a dividend on the ordinary stock. They received royalties from these companies for every telephone they used. For about three months they had a great deal of trouble with the ringing of bells, which was caused by circumstances over which they had no control. They had, however, endeavoured to obtain control, and in so doing had expended a good deal of money in law. That trouble had ceased for the present. He was not inclined to agree with Mr. Goldsworthy that overhead wires would be a great trouble to the company in the future. They heard all sorts of people of the greatest intelligence say they must put their wires under the streets. That was easy to say, but it wanted a deal of money to do it. He had it from the Post-office authorities that the leading thoroughfares in London were crammed full of wires, water-pipes, &c. The principal thoroughfares were taken up by the Government and chartered companies. It had not been demonstrated satisfactorily, he believed, that an underground telephonic service could be carried out. As to accidents from overhead wires, two years ago he got statistics from the Post-office authorities, and then only seven or eight trivial accidents had occurred. They had had no accidents brought to their notice, and he thought the alarm was pretty much a bugbear.

The report and accounts were then adopted.

On the motion of the Chairman, seconded by Mr. Forbes, a dividend was declared of 6 per cent. free of income-tax on the paid-up capital of the company for the year ending April 30th.

Messrs. Quilter, Ball, & Co., and Messrs. Price, Waterhouse, & Co., were re-elected auditors for the ensuing year at salaries of 50 guineas each.

It was next agreed, on the motion of the Chairman, seconded by Mr. Forbes, "That this meeting confirms the agreement with Mr. Robinson Kendal, dated 29th June, 1883, for granting to a company intended to be formed under the name of 'The South of England Telephone Company, Limited,' exclusive licences for the use of the company's patents in certain districts, partly in consideration of fully-paid shares in such company, and partly in consideration of royalties; and in connection with such licences to sell for fully-paid shares and cash any business now carried on by the company within the districts comprised in such licences respectively, and any property used in such business."

The Chairman then said last year one or two shareholders were anxious to have a half-yearly meeting of the company (hear, hear). The directors had no objection to have a half-yearly meeting, at which, of course, they could give the shareholders a further account of their rise and progress, and be further guided by such circumstances as appeared wise and proper (hear, hear).

A vote of thanks to the chairman and directors closed the meeting.

The Telegraph Construction and Maintenance Company (Limited).

IN accordance with the resolution of the general meeting of 28th February, 1871, a half-yearly general meeting of this company was held at 38, Old Broad Street, on Tuesday. Sir Daniel Gooch, Bart., M.P., presided.

The Secretary, Mr. E. Dickens, having read the notice convening the meeting

The Chairman said: Gentlemen, as these meetings are held rather more for the purpose of enabling you to ask us questions, as we issue no report or accounts, I shall be very glad to answer any questions which any gentleman may wish to put. In the meantime I may perhaps tell you what we have been doing during the past half-year. The total amount of cable manufactured has been 2,617 nautical miles. Of this 965 miles have been laid in the China Sea, between Hong Kong and Shanghai, for the Eastern Extension Telegraph Company; 1,204 miles have been laid in the Red Sea, between Suez and Aden, for the Eastern Telegraph Company. The *Scotia* and the *Seine* are now engaged in laying two cables for the Great Northern Telegraph Company, one between Shanghai in China and Nagasaki in Japan, and the other between Nagasaki and the Russian port on the coast of Korea. The length of these two cables is about 1,356 miles. All has been laid successfully; and the work we still have in hand should keep us going for a little longer. Then as you are aware, we took Parliamentary powers the other day to enable us to commence electric lighting. Those powers have received the Royal assent and we are now before a committee for the purpose of endeavouring to secure some portion of the lighting of London, in the neighbourhood of St. James's and that district. The matter is now before the committee, and what will be the result, I don't know. We are seeking to obtain a beginning, however; we have not, of course, lighted any place yet, but every effort will be made to secure work of that kind, in addition to our cable work. We have lighted our own works at Greenwich for the last twelve months, and the lighting is very successful. The machine we use is not only an economical one, but an effective one. If there is any question any shareholder would like to ask, I shall be glad to answer him now.

After a pause, Mr. Abbott rose and said: As one of the shareholders who was prominent in bringing these half-yearly meetings about, I think I may congratulate you and the shareholders upon the interesting statement you have just given us. The quietness with which the Telegraph Construction Company is always managed and

the unostentatious way they go about their contracts is very gratifying, and we should be entirely ignorant that you had laid so many miles of cable and so extended the submarine systems of the world if we had not had the pleasure of meeting you here to-day. The other point—that of electric lighting—will be a valuable adjunct to our submarine cable business. It seems to me that the Board of Works and the vestries seem to be contending with each other to obstruct the development of electric lighting in London. Of course you do not expect much from the mind of a vestryman, but you do expect something from the Board of Trade. What is the result? Trade is paralysed. I hope, sir, you will use your influence in Parliament to wake these gentlemen up. We want something of the kind to distribute money and galvanise trade. I repeat that I think the account of the proceedings of the half-year which you have given us has given us intense satisfaction.

The Chairman, having invited questions and received no response, said: Well, gentlemen, I think that is all the business before you to-day, and I am sorry to bring you together for so little.

The proceedings then terminated.

The India-Rubber, Gutta-Percha, and Telegraph Works Company (Limited).

A HALF-YEARLY general meeting was held at Cannon Street Hotel on Tuesday, for the purpose of obtaining the sanction of the shareholders to the payment of an interim dividend. Mr. George Henderson, the chairman of the company, presided.

The Secretary, Mr. W. J. Tyler, having read the notice convening the meeting,

The Chairman said: Our half-yearly meeting is usually an informal one, being convened merely for the purpose of recommending the payment of an *ad interim* dividend; but before moving a resolution to this effect I would briefly recapitulate the events of the past half-year. I am glad to say we have been fairly employed, and have no doubt that when our accounts are made up it will be found that we have earned a considerable profit on our outlay. Our general sales have kept up with last year's figures, and we have had some occupation—not so much as we could have wished—for our cable machinery and vessels. The *International* has had repairing work to do as well as the *Dacia*, which latter was chartered by the Government to repair some of its cables and to lay a heavy cable for Her Majesty's Post-office department which we manufactured for them early in the year. We have other work in hand at Silvertown for this department, while at Persan we are busy for the French Government. Our cable works and steamers will be partially employed during the second half of the year in the manufacture and laying of about 1,900 miles of cable to connect Spain with the Canary Islands and these again with Senegal, under concessions and money subventions from the Spanish and French Governments. These cables are to be completed and laid by the end of the year, and soon thereafter we hope to meet you again with a good account of the year's business. Meanwhile, I have simply to move that an interim dividend of 5 per cent., or 10s. per share, free of income-tax, payable on and after the 25th inst., be now declared (hear, hear).

Mr. S. W. Silver seconded, and the motion was unanimously adopted.

On the motion of Major Ramsay L'Amy, seconded by Mr. Hanson, a vote of thanks was awarded to the chairman and directors and the meeting separated.

The Birmingham and Warwickshire (Brush) Electric Light and Power Company (Limited).—The second ordinary general meeting of this company was held on Friday of last week at St. Michael's Hall, George Yard, Lombard Street. Mr. G. Matthew Felton presided, and in moving the adoption of the report, expressed disappointment at the results of the working. They had, however, endeavoured to place before the shareholders the state of the company's affairs as often as they possibly could, and they asked the shareholders to assist the directors in looking their difficulties in the face. In common with the other companies they had suffered considerably, especially from the action of the Legislature and the Board of Trade, by which serious conditions had been imposed on them, and many of the rights which they had thought they held had been taken away from them. At the last extraordinary meeting of the company there was some difficulty with regard to the Lane-Fox patent, in connection with which they were then in negotiation for the return of part of the money they had paid for their concessions. Those efforts had been so far successful in that they had obtained a return of £17,000 in shares and £4,000 in cash. During the past year they had successfully carried out an installation with a company at Saltley, and he believed the satisfaction which had been expressed there would be the means of opening up a large business for them in that vicinity. They were also carrying out an installation with the incandescent light for a firm in Birmingham, who were taking about 350 lights. That, however, was merely an experiment, and they knew there were very many workshops in the same vicinity where the incandescent light would be vastly superior to gas. They were carrying on negotiations in about half a dozen other quarters, but before concluding them they had preferred to meet the shareholders. They had undertaken no work except at a profit, nor had they endeavoured to light any large town, or apply for a provisional order. They had not sufficient capital to enable them to meet the deposit required for a provisional order, and any one who was conversant with town street lighting knew that it did not pay. They had therefore endeavoured to light firms and small districts. It was for the shareholders to determine whether they would go on with the company. The directors had been careful of the cash intrusted to them, having actually, in existing circumstances, deemed it more judicious to hire rather than to purchase plant. Mr. Daniell R. Ratcliff seconded the motion, and observed that he could not help feeling that there was a tendency in the country in favour of the adoption of the electric light. The report was unanimously adopted, and Mr. Robert Hammond was afterwards elected to a seat at the board.

The Globe Telegraph and Trust Company (Limited).—The tenth ordinary general meeting of this company was held yesterday. The report of the directors stated that the net revenue of the company for the year, after deduction of expenses, amounted to £185,374 4s. 7d., which, with the balance of £588 18s. 3d. brought forward, made a total of £185,963 2s. 10d. From this amount there had been distributed the sum of £127,880 15s. in interim dividends, and the balance of the preliminary expenses had been written off, leaving an available amount of £57,082 7s. 10d. The directors recommended payment of a final dividend for the year of 3s. per share on the preference shares, and of 3s. 6d. per share on the ordinary shares, making, with the former distributions, a total dividend for the year of 6 per cent. upon the preference and 4¾ per cent. upon the ordinary shares (as against 4½ per cent. paid last year), carrying forward a balance of £1,365 9s. 10d. The directors had recently acquired by exchange 652 Ten per cent. Preference Shares of the Direct Spanish Telegraph Company. They had also taken up the company's allotment of 11,830 shares of the recent issue of the Eastern Extension Company at £11 per share.

The Eastern Telegraph Company (Limited).—The directors are prepared to receive subscriptions for £500,000 £4 per cent. mortgage debenture stock. The price being £95 per £100 stock, payable £5 per cent. on application, £45 per cent. on allotment, £45 on 1st October, 1883, with option to pay in full on allotment under discount. The issue is made for redemption of terminable debentures falling due in October next, and for payment for the Trieste-Corfu Telegraph Cable and other important expenditures on capital account.

The Submarine Telegraph Company (Limited). The accounts for the past half-year show a balance, subject to audit, enabling the directors to recommend, in accordance with the resolution adopted by the proprietors at the last half-yearly meeting, that 15 per cent. instead of 10 per cent. of the gross receipts be added to the reserve fund, and that a dividend be declared at the rate of 11 per cent. per annum.

The Western and Brazilian Telegraph Company (Limited).—At a meeting of the Board of this Company held on Thursday of last week, an interim dividend was declared of 3s. 9d. per share, or 1¼ per cent. (free of income-tax) on the ordinary shares, equal to 2½ per cent., the full half-yearly dividend, on the preferred shares, for the half-year ending 31st March. The dividend will be payable on Wednesday next.

The Eastern Extension, Australasia, and China Telegraph Company (Limited).—This company states that the coupon on their Six per Cent. debentures, due on Wednesday next, will be paid on and after that date at the Consolidated Bank, 52, Threadneedle Street, E.C. Coupons must be left three clear days for examination.

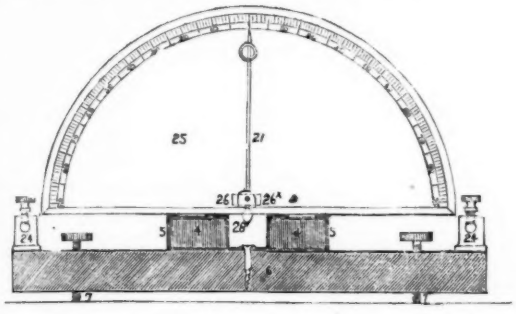
ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

5754. "Electrical switch for electrical lamps, &c." G. W. BAYLEY. Dated December 2. 6d. Consists in constructing and arranging the parts of an electrical switch in the following manner, whereby the "arc-ing" described is prevented or so far diminished as not to affect the action of the switch. On a base of insulating material are fixed a short distance apart two metallic bars parallel to the base and to each other. Each of these bars is divided through the greater part of its length so as to make it into an elastic fork, having a figure somewhat resembling that of a tuning fork. The free ends of the forks are broader than the other parts and are inclined inwards, that is, the inclinations are concave. On the base of the instrument is a sliding metallic bolt, having two arms which are in a line respectively with the two elastic forks. The ends of these arms are inclined convexly, so that when the bolt is pressed towards the forks the convex inclined ends of the said arms bear against the concave inclined ends of the elastic forks, the ends of the said arms and forks having a large contact surface. Owing to the elasticity of the forks the pressure of the arms against their ends expands the said forks and causes the metallic contact to be very effectual, as well as extending over a large surface. The two forks are included in the electrical circuit, and when the bolt is pressed home the circuit is completed by the arms of the said bolt connecting the said forks, and when the said bolt is withdrawn the circuit is interrupted without the usual "arc-ing."

5580. "Manufacture of carbons, candles, electrodes, &c." W. CUNLIFFE. Dated November 23. 6d. The invention is designed for the better, quicker, and more uniform manufacture of the articles described, &c., by the new and special arrangement of certain mechanical devices and automatic machinery, whereby a regular and uniform pressure, and compression of the plastic, or other material, is obtained and maintained in a sealed and air-tight chamber, before the same is passed through the dies or to the formers, until the articles are discharged from the same, whereby a more uniform and consolidated and improved quality is obtained. And for the arrangement of such machinery and mechanical devices, after the compression and expulsion of the material from the chamber, for the automatic cut off and sealing of the orifices or channels leading to—or of the dies, &c., air-tight, so that on the withdrawal of the plunger, or other device for such compression, the atmospheric pressure upon the supply of plastic material in the hopper, or other holder, forces a fresh supply or charge forwards into the hopper, &c.'s, exit and vacuum formed in

the chamber, and so on after each stroke intermittently. And also for the arrangement of certain devices and machinery for the variation and regulation of the quantity of materials so subjected to compression, and passed through the dies or formers by the operation of the plunger or other device. And further, for the combination of one or more plungers and cylinders, or chambers, pistons, connecting rods, hoppers, guide pieces, clamps, dies, and other mechanism, with the valve chest, reciprocating valve, and automatic pressure valve action operated either by hydraulic or other power.

5669. "Apparatus for measuring or indicating electric currents." J. BLYTH. Dated November 29. 6d. Has for its object the providing of improved, simple, convenient, and reliable apparatus for measuring or indicating electric currents. One arrangement of the apparatus is that described in the number of the ELECTRICAL REVIEW for May 5th, 1883. The figure is a vertical section of a simplified modification suitable for cursory observations to be made when the indication is not required to be minutely accurate, and which the inventor terms a current indicator. The solenoid, 4, is represented as consisting of a single volute or coil of insulated copper ribbon enclosed in a case, 5, fixed to a wooden base, 6, and having the ends of the ribbon connected to terminals, 24. A semicircular frame, 25, with a graduated dial, is fixed upon the solenoid case, 5, and above



the centre of the solenoid there is supported on pivots a piece of soft iron, 26, or it may be a small permanent magnet. When using a piece of soft iron it is pivoted adjacent to one of its ends and is provided with a projecting or depending counterpoise, or there may be added to one end of the soft iron piece a counterpoise, 26×, of brass, the combined piece being pivoted centrally of its length. When using a permanent magnet it is pivoted centrally of its length. A pointer, 27, is fixed to the iron piece or magnet, 26, which has also fixed to it below its centre a brass weight, 28, to counterbalance the pulling down force which an electric current exerts on the free end of the piece of soft iron, or on one or other of the ends of the magnet, 26. There may be used two such pieces of soft iron pivoted so that their pointers will move in opposite directions over different segments of the dial. This instrument will indicate what is understood as the direction of an electric current as well as its strength.

5711. "Manufacture of conductors for electric currents." W. R. LAKE. (A communication from abroad by F. K. Fitch, of America.) Dated November 30. 4d. Relates to improvements in conductors for electric currents, and has for its object the production of a wire of the greatest possible strength and the least possible weight, while retaining sufficient conductivity for the purpose intended. It consists in making a compound wire or conductor of phosphor-bronze and copper, whereby (the bronze being of enormous tensile strength) the cross-section of the wire may be comparatively small, while its conductivity is about 2½ times that of steel or iron. The copper portion of the compound wire forms the principal conductor. This compound wire does not give rise to injurious galvanic action, as is the case with iron and zinc, or steel and copper compound wires.

1883.

1347. "Dynamo-electric machines." H. H. LAKE. (A communication from abroad by G. W. Fuller, of America.) Dated March 13. 6d. Relates to certain special features of construction in the dynamo-electric machines employing an armature core which is independent of the coils surrounding it, and which is made to preserve unchanging polar relations to the field magnets.

1357. "Thermo-electrical generators." R. H. BRANDON. (A communication by E. G. Acheson, of Paris.) Dated March 14. 6d. Has reference to thermo-electrical generators, and it consists of a novel and simple arrangement whereby less resistance is obtained and more current is generated, the electromotive force remaining constant. The pile is constructed as follows: The metal, or other suitable materials forming the couples are in the shape of discs; each disc is connected to the other at its periphery by soldering or other appropriate means, these two discs forming one couple. The separate couples are connected in series with each other at the hole cut in the centre of the discs. Fig. 1 is an elevation in cross section, and fig. 2 is a plan of the invention. Each element is formed of a couple of discs made of the materials generally used in thermopiles, one of which, *a*, is flat, and is connected to the other, *b*, at its periphery by soldering or other appropriate means. In the centre of the discs, *a*, is pierced a hole, in which is adapted and soldered the central part of the lower disc, b^1. Between each pair of discs forming a couple is interposed a sheet of mica, or other appropriate insulating material An insulating washer, *c*, is also placed between each couple, and small blocks, *d*, made of any suitable insulating material, may be placed between each couple to act as a support. The conducting wires, *e f*, are fastened at any convenient point of two different couples. In order to compensate for the expansion and contraction of the discs, the discs, *b* b^1, are provided at their periphery with a number of tongues, *g*, which are separately bent into the suitable

FIG.1.

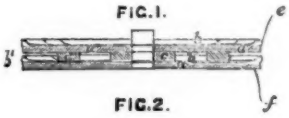
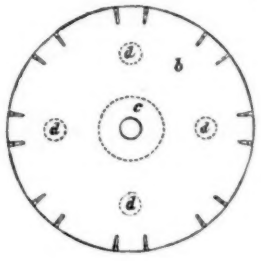


FIG.2.



shape and soldered to the outer periphery of the discs, *a*. Heat is applied at the junction of the discs, either in the centre or round the circumference, using a Bunsen burner or other convenient means of heating, and a wire gauze may be applied on to the lower face of the lowest disc, *a*, to prevent the flame of the burner from passing through, and thus create uniformity in heating.

1375. "Dynamo-electric machines." H. H. LAKE. (A communication from abroad by G. W. Fuller, of America.) Dated March 14. 8d. Relates to the application to dynamo-electric machines having cylindrical armatures, of an armature core independent of the induction coils surrounding it, and held in unchanging polar relations to the field-magnets by the attractive force of the field-magnets. According to the present invention the armature core is of cylindrical form, and is loosely mounted upon a rotating shaft, upon which the induction bars are supported, and by which they are rotated, the field-magnets being stationary. The said invention also comprises a special arrangement of field-magnets in connection with pole-pieces and a method of so connecting the induction bars, which traverse the armature, with each other and with the commutator, that the inventor is enabled to avoid great elongation of the armature.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

Letters respecting Advertisements, Subscriptions, &c., should be sent to the "Publisher," ELECTRICAL REVIEW, at above address.

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CORRESPONDENCE.

Underground Wires.

In your leading article on "Underground Wires," in your issue of July 7th, you state that up to the present time no really cheap and satisfactory system has been devised.

The reason why so little has been done in this country is probably that indicated in a succeeding sentence of your article, namely, that the difficulties which the subject presents can be only thoroughly realised by those who have had experience of the kind, an experience which, except in telegraphy, it has scarcely been possible to gain in England. Abroad, however, the Berthoud-Borel underground cables may claim to have satisfied all the necessary tests, both of time and experience, and they are certainly cheap. I have by me as I write a piece of one of these cables, for telephonic purposes, specially manufactured for the Swiss Government. It consists of 50 copper wires of No. 18 B.W.G. insulated by the Berthoud-Borel patent material, and protected by two concentric sheathings of lead, each about two millimetres thick, and separated by a thin layer of gas tar. These cables are laid in the ground, at depths varying according to circumstances, just as they are uncoiled off the drums, and without being enclosed in iron or other pipes. At present the whole of the telephone wires in Berne are being laid underground by means of this type of cable.

Several cables have already been underground for upwards of three years, and none of them show the slightest deterioration whilst their insulation remains as perfect as at first. These are covered by a single lead sheathing, but for general underground purposes it is preferable to employ two sheathings separated as above mentioned. In Paris the Société Générale des Téléphones has already about 10 miles of the Berthoud-Borel cables laid underground.

Many miles of these cables for electric lighting have been laid underground in America and on the Continent. The Berthoud-Borel insulating material (whose inductive capacity, by the way, is much lower than that of gutta-percha), is specially suited for this purpose, as it is not destroyed by heating of the wires. In ordinary cables, if the wire gets heated the gutta-percha softens and the conductor by its weight presses through it, thus lessening the insulation. This does not take place with the Berthoud-Borel cable in which the covering consists of a textile material in conjunction with a cheap insulating substance prepared at a very high temperature.

A large cable on this principle is at present being manufactured for the lighting up of the town of Boudry, the power being derived from a waterfall of the Reuse, about a mile distant.

In this installation Swan lamps and the storage batteries of Mr. C. Vernon Boys will, I believe, be used.

Messrs. Berthoud and Borel have worked continuously during the last four or five years at the perfecting of their cables, and I think they may be congratulated on the success which they have attained.

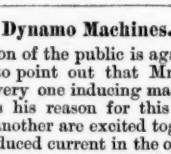
J. G. Lorrain.

1, Wardrobe Place, Doctors Commons, E.C.
July 19th, 1883.

Dynamo Machines.

Now that the attention of the public is again drawn to the Gordon machine I should like to point out that Mr. Gordon is mistaken in using two induced to every one inducing magnet.

Mr. Gordon urges as his reason for this that when two coils in close proximity to one another are excited together the current in one sets up an opposition induced current in the other. To every thinking electrician this reason must appear ridiculous, for the core of No. 2 will stimulate or increase the flow of current in No. 1, and this to a much greater extent than the induction of the wire upon wire, which is of course exceedingly small, for it cannot be as much as the opposition current induced in the coil itself by layer on layer and turn on turn, for it is further off.



Mr. Gordon may urge his oft-quoted experiment as proof of his theory, but he was mistaken as to the cause of the effect, for it evidently was not what he ascribes it to; it probably was owing to the magnets of No. 2 set augmenting the current in the No. 1 coils that the current was greater in No. 1 circuit when circuit No. 2 was open. Of course, then, when the No. 2 circuit was closed the induced current of the No. 2 magnets was taken off; and possibly if this circuit were closed on a lower resistance than circuit 1, part of the magnetism of the No. 1 magnets was spent in inducing the current in the No. 2 circuit.

I certainly think that Mr. Gordon's machine is a very grand piece of electrical engineering, but I think that all will agree with me in saying that if Mr. Gordon had studied the subject closer and not gone out of his way to overcome fancied difficulties he would have produced a better and cheaper machine, for by using the same number of field-magnets as armature coils he would have been able to have made a very much smaller machine do as much work as his large ones.

H. T. Barnett.

Woodville, Abbey Road, St. John's Wood.

The United Telephone Company and its Claim to the Exclusive Use of Carbon in a Transmitter.

This company, it appears, persists in its publication of its exclusive right to the use of carbon in a transmitter. I unhesitatingly pronounce this claim, to use the words of Mr. Justice Fry, to be "dishonest and false," and I further say that that company well know it to be a dishonest and false claim, they themselves having obtained clear and definite definitions of the claim in Edison's patent from Lord McLaren in the case of the United Telephone Company against Maclean, and also from Mr. Justice Fry in the case of the same company against Harrison, Cox-Walker.

Edison's solitary claim in his patent 2,909, 1876, is in these words: "In an instrument for transmitting electric impulses by sound, the combination with a diaphragm or tympan of electric tension-regulators substantially as hereinbefore described for varying the resistance in a closed circuit substantially as set forth."

Lord McLaren said, "Edison's patent is not for a specific instrument, but for a combination," and "I suppose if Theiler dispensed with a diaphragm, he would be without the patent, because the tension of the diaphragm is the material point?" To this the Lord Advocate, counsel for the United Telephone Company, replied, "Yes." Lord McLaren then continued, "Now, as Edison's patent is for a tension-regulator in combination with a diaphragm or tympanum, it follows that the interdict would not apply to the use of the respondent's *carbon* regulator without a tympanum."

In the case of the United Telephone Company against Harrison, Cox-Walker, Mr. Justice Fry said, "The true meaning of the claim in Edison's patent is the union of a tympan or diaphragm capable of vibrating under the sound-waves, with an electric tension-regulator," and "I have concluded that Edison described the essential requisite of his invention to be the combination of a vibrating diaphragm and a tension-regulator."

Lord Cairns (in cases L. R. 1 app. Ca. 575, also L. R. 3 app. Ca. 34) used these words, "If it is clear that the claim is for a combination and nothing but a combination, there is no infringement unless the whole combination is used, and it is in that way immaterial whether any or which of the parts are used." It seems almost incredible that any person possessing common sense would presume, in face of the decisions above quoted, to claim that Edison's patent secures to the United Telephone Company the exclusive right to use carbon in a tension-regulator; but such is the cool impudence of the United Telephone Company that they distinctly claim the exclusive use of carbon in a tension-regulator, and have the audacity to circulate a publication in which is the following sentence: "Proceedings will be taken against any person manufacturing, selling, supplying, or using—except under licence from the United Telephone Company—any forms of transmitter in which carbon or any equivalent substance is employed, whether in the form of hard pencils or in the form of loose powder."

I submit to you, Messrs. Editors, and to the public, can a more dishonest and false claim be made? Does not the judgment of Lord McLaren decide that the use of a *carbon* regulator without a tympanum or diaphragm to be without the patent; and is it not in evidence that the counsel for the United Telephone Company admitted this fact? In persisting to make this claim the United Telephone Company cannot plead ignorance, nor can it plead they do so under advice of counsel. The solemn judgments of two courts—judgments obtained by it after two long-contested cases, and accepted by it—have decided that the use of carbon in a tension-regulator without a diaphragm is without Edison's patent.

In view of the fact that Lord McLaren and Mr. Justice Fry have decided that the use of carbon in a tension-regulator without a diaphragm is not within Edison's patent, the United Telephone Company, in persisting to claim the monopoly of the use of carbon in a tension-regulator, presumes to set aside the judgments of those two learned judges; and until those judgments shall be reversed by a higher court on appeal this claim by the United Telephone Company is impudent and dishonest.

I take this opportunity to inform the public and to give notice to the United Telephone Company, Limited, that the Molecular Telephone Company is having made and is selling and has sold telephone transmitters, made under Lockwood and Bartlett's patent, No. 2,418, 1880, in which *carbon* is used without a diaphragm or tympan. This patent is owned by the Molecular Telephone Company of New York, and this company is prepared to defend the validity of the patent, and also to take legal proceedings against all persons who may attempt to injure its property in any manner.

W. C. Barney,
Representative of the M. T. Co.

19, York Street, Portman Square, W.
July 23rd, 1883.

[Our correspondent has apparently confounded the examination in the Scottish Court with the judge's decision. We desire to say, further, that Mr. Justice Fry's statements that the company was "not honestly asserting its right" referred only to the Hunnings' transmitters, which are exempted by the fiat of the Attorney-General, and not to carbon transmitters generally.—EDS. ELEC. REV.]

The "Pilsen," "Joel," and General Electric Light Company.

[We have been requested by Mr. Pilditch to insert a copy of the following letter addressed by him to Messrs. J. G. Osborne & Co.]

City Bank Chambers,
20, Threadneedle Street, E.C.
July 23rd, 1883.

Sirs,—The attention of my client, Mr. George Alfred Corderoy, has been called to a paragraph in a circular appearing in the TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW of July 21st inst., and purporting to have been recently issued by you, in which it is stated (1) that Mr. Corderoy has consented to act as one of the first members of the committee of shareholders in the "Pilsen," "Joel," and General Electric Light Company (Limited), and (2) that he represents 200 shares.

I am instructed to inform you that Mr. Corderoy has given no authority to you or to any other person to make the above statement, nor is it true in any particular.

Yours faithfully,
(Signed), **F. Slater Pilditch.**

Messrs. J. G. Osborne & Co.,
27, Red Lion Square, W.C.